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and

GOLDFISH

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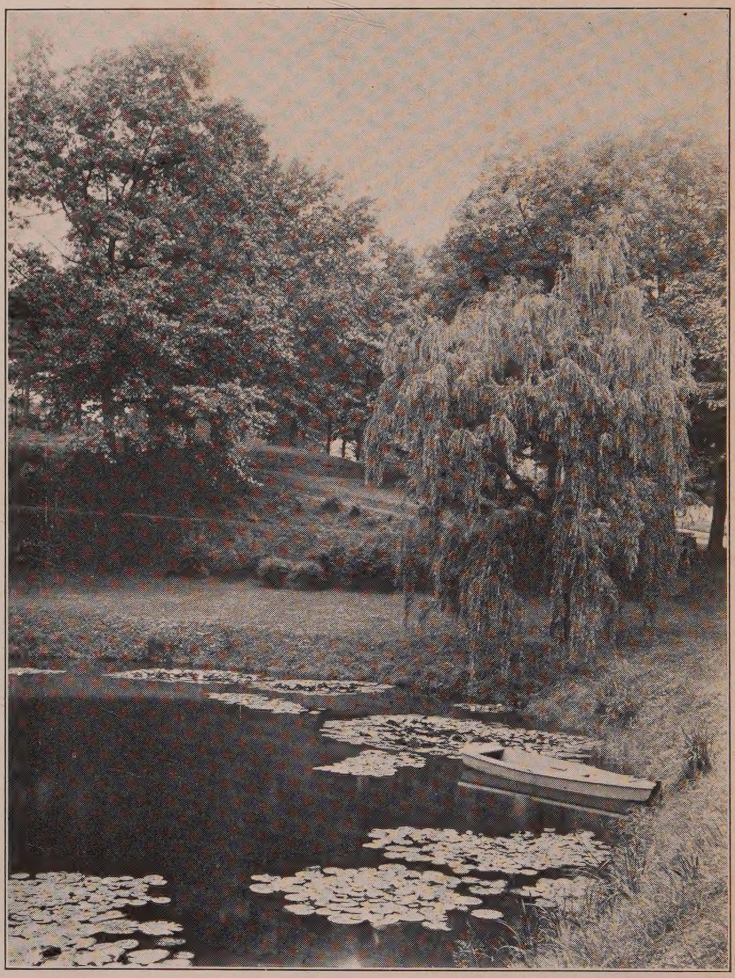

A vision of serenity and calm, this pool merits more than passing notice. The charming environment of shrubbery and the graceful foliage of the trees adapt themselves perfectly to its peacefulness and beauty

WATER GARDENS
and
GOLDFISH

By
ROBERT V. SAWYER
and EDWIN H. PERKINS

New York
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1928

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Publisher's Foreword

WATER GARDENS and GOLDFISH

HERE is a De La Mare Garden Book that we fairly believe is going to be appreciated—a book that should become popular, because it is intended to add to the joys of living of that vast army of gardening enthusiasts who are ever ready to venture into unknown fields, in order to extend their knowledge, provided there is held out to them visible prospects of satisfaction for their efforts. The lover of a garden is ever ready to embrace the opportunity to enjoy new revelations of the mysteries of plant life.

The two subjects have been incorporated into one book, for the reason that while either will stand alone, Goldfish impart an additional pleasure to the aquatic garden.

The Water Garden section was written by Robert V. Sawyer; the Goldfish section by Edwin H. Perkins. Both are recognized authorities in their respective fields and have covered their subjects in lucid and concise form, with the result that the recommendations conveyed in their text are easily understandable.

Water Gardens and Goldfish is not intended for the estate owner (although we have no objection to his using it), but for the plain, everyday man or woman whose gardening ideals look ever to new fields of accomplishment and the production of tangible results.

The illustrations for the Water Garden section are drawn from many states and practically all of them represent amateur effort. They form an important part of the book and should give the reader many an idea in the planning of his or her own individual garden.

The Goldfish illustrations are extremely valuable and the author pronounces them the most lifelike reproductions he has ever seen.

A. T. De La Mare.

PART I

WATER GARDENS

By

ROBERT V. SAWYER

Chapter I

WATERLILIES ON A BALCONY

EVERYBODY can have Waterlilies. They are so easy to grow.

If you are a dweller in an apartment house and have but a corner of a sunny balcony at your disposal, you are in luck; but if you have a comparatively large balcony, say three by six feet, you are indeed fortunate.

Water-hyacinth (*Eichhornia*), with its rosy-lilac flowers, resembling an Orchid, growing luxuriantly in a pan

Primrose-willow (*Jussiaea longifolia*), a good aquatic, growing two to three feet high and bearing rich, golden-yellow flowers like an Evening Primrose

Water-hyacinth, Water-snowflake and Pygmy Waterlilies

First, plant a Water-hyacinth in a six-inch bowl filled with loam, or, better still, make it three or four plants in a ten-inch dish. Be generous with them, for this Water-hyacinth may be the queen of your balcony garden. Next, if space permits, plant a Water-snowflake in a twelve-inch dish filled with loam and water; it will flower and multiply unbelievably. If you still have vacant space, plant a white pygmy Waterlily (Nymphaea tetragona) in a fifteen-inch crock—a crock not being available a large pan will answer. If it should be an eighteen-inch container, add a yellow pygmy Waterlily (Nymphaea tetragona helvola), for in this large

space, one pygmy Waterlily may seem lost. These will bloom generously all Summer, bearing white and yellow blooms somewhat larger than cherry blossoms. You will want a couple of small goldfish in your big eighteen-inch ocean, too.

Anyone of the half dozen pink or blue varieties of Waterlilies will flourish if you can make room for a twenty-four inch tub.

Other Water Plants for the Balcony Garden

In any one of these tubs you may also place several plants of Arrowhead, Parrotfeather, Umbrella-sedge, Papyrus or Primrose-willow. Other plants which may be included in the garden are Floatingheart and Waterpoppy. In a large jardinière of loam and water they will bloom freely and sometimes crowd over the sides.

The Nymphaeas suitable for use in a twenty-four inch tub are blue, purple or red Zanzibar, Dauben, Pennsylvania, Mrs. Woodrow Wilson, Panama-Pacific, and the Blue Egyptian Lotus (Nymphaea caerulea).

A pretty plant with floating leaves and yellow flowers is the Waterpoppy (*Hydrocleis nymphoides*), here growing in a dishpan

An example of perfect taste and symmetry is shown in this view, taken in a New York State garden. The background, with its fringe of blossom, leaves little to wish for in artistic effect

Soil and Water

The best soil for water plants is three parts clayey loam and one part rotted cow manure; but, in an apartment, this may be difficult to procure; therefore, to any topsoil which can be obtained, add just a little sheep manure, say about ten per cent, and unless the soil is particularly poor, your plants will be too polite to notice the difference.

The Waterlilies mentioned will be happy in from three to twelve inches of water—they are not the least bit particular. The other plants mentioned are even less particular, doing well with an inch or two of water above the soil.

As to the amount of soil, you need not worry. If you are in doubt, however, fill your jardinière or crock about half full of soil and feel confident that all is well. For the Water-

The maker of this pool, which is at Pelham, N. Y., proved a skillful hand in not overcrowding. He shows us, in the foreground, Water-hyacinth (*Eichhornia crassipes*); at the right, Parrotfeather (*Myriophyllum*); in the background, Umbrella-sedge (*Cyperus alternifolius*) and Sweetflag (*Acorus calamus*), and the main part of the pool occupied by Nymphaea hybrids Mrs. C. W. Ward and Blue Beauty. A glimpse at the picture attests the good judgment of the planter

lilies mentioned, several inches of soil in the bottom of the tank will do, or they may be planted separately in five-inch pots full of soil.

Wintering the Plants

The Pygmy Waterlilies are hardy and may be buried in the ground below frost line, or they may Winter in an aquarium in a cool, sunny window. The other Waterlilies mentioned are tropical, and in the Winter are difficult to handle outside of a greenhouse. Better discard them and buy new ones next season. If kept in a five-inch pot, though, they may exhaust the food supply in the soil and "go to sleep" just to

Yellow Pygmy Nymphaea (*N. tetragona helvola*). A very dainty yellow variety and extremely free flowering

forget how hungry they are. In this case, the leaves gradually die, but the plant forms a bulb about the size of an acorn. This bulb may be kept in the cool aquarium with the Pygmy Waterlilies, or it may be kept in wet sand. Better give your plants more soil, however, to keep them growing, for when the plants become dormant it may deprive you of half a season blooms. Nymphaea Dauben seldom forms a bulb.

If bulbs are kept over, start them about April in a bowl of sandy soil and water in a warm, sunny window. Here is the opportunity to supply your neighbors with Waterlilies. When the bulb develops a good-sized sprout with, say four or five floating leaves, break the sprout off and plant it separately. The bulb will continue to grow new sprouts as long as your patience holds out and you continue breaking the sprouts off. That is how tropical Waterlilies are propagated. They can also be propagated from seed successfully.

Arrowhead is hardy and forms odd-looking bulbs—duck potatoes. Bury these or Winter them in the cool aquarium.

Waterpoppy will sometimes thrive when planted in sand in an aquarium. Parrotfeather, Water-hyacinth, Snowflake and Papyrus are difficult plants to Winter, except in a greenhouse. The Umbrella-sedge (Cyperus) is tough and will Winter well "on top of the piano" or in any other place.

White Pygmy Waterlily will multiply rapidly from seed, and the yellow variety by offshoots, in case you wish to increase your stock. The nice thing about Pygmy Waterlilies is that they are perfectly at home in small quarters—they do not feel at all cramped. The tropical Waterlilies, on the other hand, will strain against the sides of their containers and make you yearn for larger space for their accommodation.

Chapter II

BACK YARD PONDS

WE longed for a back yard once—and, well, here we are! Getting a back yard is such a mixed-up affair, we almost forgot our real reason for moving. Here it is the middle of June—and never a Waterlily!

The easiest and quickest way to make a water garden is to procure some metal or wooden washtubs or barrels sawed in two. Sewer pipes cemented at one end can be used, old

This pool seems perfectly at home in its natural setting. It was designed and constructed in a single afternoon by two amateurs. It must be conceded that professionals could not have accomplished a more pleasing effect

These trail pools are at Lowell, Mass., and have as a foundation an old wooden tank about four feet long and a foot and a-half deep and wide, and a hardwood barrel, heavily crossed, cut in two and set in the earth to clear the overflow from the tank will enter the first section and thence passed on the other through little connecting channels. That the denizens of the pools favor such treatment is evident from their contented appearance

For naturalistic effect this view from Akron, O., would be hard to equal. It was made by simply sinking a barrel in the earth, placing stones around the rim, and arranging the plants to harmonize with the setting. So easily constructed, but what a joy in its ownership!

watering troughs, tight wooden boxes, or anything else that will hold water. Sink them in the ground, fill them with soil and water and you are ready to plant.

What Varieties to Select

Large tubs or half-barrels will accommodate most of the varieities of Waterlilies except the giant-sized ones. Since your pond space is limited, select only the freest flowering varieties. A three- or four-foot tub will accommodate most of the tropical day bloomers, which come in white, red and blue, and all of them are free flowering. A four-foot tub will accommodate any of the night-bloomers, but they may be a little cramped. These come in white, red and pink, the

latter being especially fine. But remember, night-bloomers are not as contented in tubs as are the day-bloomers, so you had better make them your last choice if space is limited.

Hardy Waterlilies do well in tubs, but select only the small and medium growing varieties; these come in white, yellow, pink, orange and red.

Glory, a lovely shade of rosy red, is the freest blooming Nymphaea. It can be counted upon for steady bloom from June to October. The plant is moderate in size and well suited to tub gardening.

Nymphaea Comanche. Large flowers of a rich apricot color, changing to a dark copper-orange, streaked with glowing red

For a good white, Gladstone, White Marliac, Hermine or Pygmy Waterlily may be selected.

There are a number of varieties combining pink or red with yellow; these are light in color when they open and turn darker. Among the best are Aurora, Paul Hariot, Sioux, Comanche, Robinson and Solfatare. Aurora opens a pale mottled orange and soon darkens to a mahogany-red; it is a small plant, almost dwarf, and is just made for tubs.

Another good Nymphaea, too long neglected, is Laydeker Purple. The name is misleading; the plant is really a small edition of Glory Nymphaea and deserves a high place.

In pinks, the most prolific are Morning Glory, Rose Marliac and Flesh Marliac.

For a deep red, try Laydeker fulgens, Vesuve or Escarboucle. These three are almost identical and all are excellent bloomers. William Falconer is similar to these in coloring but is not as free blooming.

If you can spare another tub, try the Lotus, in yellow, pink, white or red, in single or double form. The double varieties bloom a little more freely in small quarters than do the single. In a tub you may or may not get any blooms, but if not, you can still admire the leaves. Lotus leaves are umbrella-shaped and stand several feet above the water. They are covered with a delicate bluish mist and are very beautiful.

The Lotus grows from banana-shaped roots; the single varieties will grow from seed.

Deserving Water Plants

We must never forget, however, that besides Waterlilies there are a great number of deserving water plants. Here are some of the leading ones:

Tropical: Waterpoppy, Water-hyacinth, Papyrus, Umbrella-sedge, Waterlettuce, Primrose-willow and Water-snowflake.

Variegated Sweetflag (*Acorus variegatus*), a hardy aquatic

Hardy: Parrotfeather, Wildrice, Water-clover, Pickerelweed, Variegated Sweetflag, Floatingheart, Arrowhead, Cattail, Marsh Forget-me-not and Duckweed.

Don't think that this represents all the desirable water plants; there are many more listed in the catalogs of aquatic plant growers.

When to Start a Water Garden

June is not too late to start a water garden. Tropical Waterlilies and Lotus are going to benefit by the delay because the higher temperature will help them to become established. Hardy Waterlilies will not be harmed by the delay, as they are not particular about the time of year. Many water gardens are planted as late as July or even August with success, but, of course, early June is best.

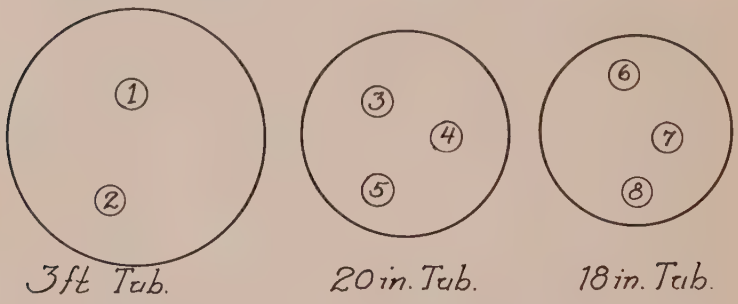
Tub gardening offers unlimited possibilities. Many gardeners are combining tub gardens with rockeries, which can be worked out very well, but it is a case of riding two hobbies at once and that may become too strenuous.

The reader has no idea of the number of varieties that

can get along peaceably in three or four tubs or half-barrels; and one need not be alarmed about the expense, for a simple layout can be made most reasonably.

Three Suggestions for Back Yard Pools

Here is a very pretty yet inexpensive layout:



1. Nymphaea capensis or Cape Waterlily
2. Water-snowflake
3. White Pygmy Waterlily
4. Arrowhead
5. Yellow Pygmy Waterlily
6. Waterpoppy
7. Water-hyacinth
8. Wildrice

The plants will cost about four dollars. You may be able to pick up the tubs or half-barrels for nothing.

If extreme economy is necessary, you can buy enough Zanzibar Waterlily, or perhaps Lotus seed, for a quarter to fill twenty tubs with plants, or you can confine yourself to local native varieties, gathering them yourself. All that is needed to start a water garden is the inclination.

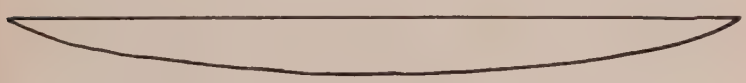
Chapter III

CONCRETE PONDS

A SQUARE egg would be a pretty weak proposition, so Nature makes it all curves, with great economy of building material.

An Economically Shaped Pond

Therefore, in building a cement pond, see that it is curved at the sides and bottom, and you can get along with about half the material that a straight-sided pond requires. In cross section, it would look like this:



In other words it should be shaped like a saucer, except that a saucer has a flat foundation, whereas this pond is curved all the way.

In case you contemplate moving in the Fall, and still want a real pond that will do for the Summer, you will be surprised what a pond you can make for a few dollars, providing you do the work yourself and can obtain sand and gravel cheaply. This pond will not stand the Winter, but it will be easy to remove the wreckage in the Spring.

The pond should be about twelve feet across and eighteen to twenty-four inches deep in the center.

From Oklahoma City, Okla., comes this ideal of refinement and taste. Note the perfect harmony of the surroundings; the restful atmosphere seems almost contagious

Excavating

To make the excavation, start shoveling from the center and throw the earth toward the outer edge in such a way that, as the center becomes deeper, the edges become higher. In this way you will not have to dig very deeply to get the proper depth, and it will not be necessary to haul away any earth. Pack the earth down hard and smooth and determine the line of the outer edge with a spirit-level.

Cement Mixture

Now mix very thoroughly three bags of cement, six cubic feet of sharp sand and nine cubic feet of gravel or crushed stone; add just enough water to make a real heavy, slabby mixture. It should be stiff enough to stay put and wet enough to look wet when patted or troweled. Line the depression with this cement mixture in an even layer about an

This beautiful example of planting with the harmonizing Lily pool is at Los Angeles, Cal. A more dignified conception would be difficult to find

inch thick. Smooth it down thoroughly and carefully and then brush it with pure cement and water mixed to the consistency of cream. Brush this on with a broom and then cover with newspapers to prevent drying out. Concrete sets much harder if kept damp.

After the third or fourth day the pond may be filled with water.

No plumbing is needed in such a pond; it may be filled with water by means of the garden hose and emptied to a lower part of the garden by syphoning with a hose.

Do not put plants or fish in the pond until the water has been changed at least three times; this is necessary to soak the lime out of the concrete.

The concrete mixture used in this pond is called a "one-two-three" mixture, as it consists of one part cement, two parts sand and three parts gravel or crushed stone. No stronger concrete can be made, and it is waterproof if worked carefully.

Should you change your mind about moving, you may be able to save the pond over Winter by letting the water remain and filling it up with leaves, taking particular care to protect the edges with manure or heavy litter.

A Winterproof Pond

To make the pond Winterproof, it had better be made in this way:

1. Use three times as much concrete mixture, so as to make it three inches thick.

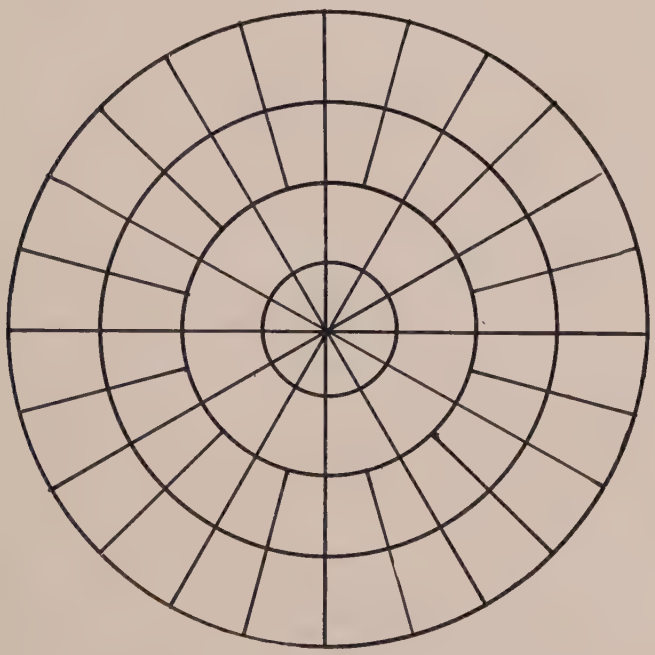
2. Reinforce with one-quarter or three-eighths inch steel reinforcing rods, a foot and a-half apart each way throughout, using a complete circle of the same rods around the rim.

3. Have an eight-inch layer of cinders under the pond.

The material will cost about thirty dollars.

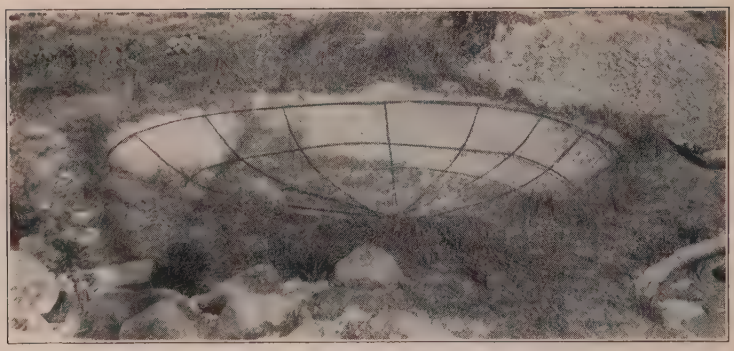
There is some doubt about the need for cinders under a pond. Many satisfactory ponds are made without them.

As you look down on the job from above, the reinforcing rods will present this appearance:



The rods should be wired together wherever they cross.

It is somewhat of a task to get these steel rods all marshaled into shape, but, as a rule, they are not very difficult to handle. In some places they will have to be set up a little on stones, and in other places they will have to be staked down with short steel rods to hold them in position. The stones and rods will not weaken the concrete if they are clean. If you should ask a concrete worker's advice, he will say: "Use a



Twelve-foot concrete pond in construction

leaner mixture; use a finishing coat." Ignore such advice. My experience has taught: "Do the job yourself, or superintend the job yourself, and it will be done all right." Do not, under any circumstances, hire a regular cement worker. I apologize to cement workers, but my experience has been that they seldom make a leakproof pond. And do not use a finishing coat; it always peels off.

Repairing Cracks

Once a concrete pool cracks it is almost beyond repair. It cannot be permanently repaired with more concrete, because the edges of the cracks spread in time and the patch breaks. The leak may be temporarily stopped by packing sticky clay along the crack, or it may be chiseled out about an inch wide and filled with soft tar; or brushing cement mixed with water into the crack may give temporary relief. But better build a pond that will not crack.

Do not try to construct a beautiful rustic pond with rocks and cobble stones built into the sides. Rustic pools are artistic, but seldom hold water. Of course, if it has to be rustic, make a substantial, leakproof concrete pool first and, later, add the rustic effects.

Glory Nymphaea in pool, ornamental grasses, used as a background, creating a charming ensemble. This picture comes from St. Louis, Mo.

"Where Waterlilies and grasses meet" might be an appropriate title for this picture, which was taken at Los Angeles, Cal. The rear planting, which includes Caladium esculentum, Cyperus and Pennisetum, is strikingly effective

The pool here described will look better if sunk flush with the surface of the garden or a few inches below. Then the sod may be induced to encroach just enough to hide the rim, and the pond will look natural and unassuming.

A Straight-sided Pond

There are, of course, cases where one has no wish to hide the rim; one may prefer a straight-sided pond, using a wooden form for the sides. It will be a good pond and can be very artistic, only there are these drawbacks: First, building the form is liable to prove a bigger job than one bargains for. It is like building a young house. In the second place, twice the amount of concrete is needed where there are straight sides and square corners.

If one prefers such a pond, however, here are the specifications for an excellent one:

Twenty feet long.
Ten feet wide.
One and one-half feet deep.
Bottom, six inches thick.
Sides tapered on the outside, eight inches thick at bottom and six inches at top.
Reinforce with steel rods or heavy fence wire.
Remember to reinforce the corners and angles extra well, as they are very prone to crack.
Use 40 bags cement, 80 cubic feet of sand, 120 cubic feet of stone or crushed rock and 320 feet of twisted steel rod.

If the pond is two feet deep, it requires 50 bags of cement, 100 cubic feet of sand and 150 cubic feet of rock.

The form is made of inch boards and must be heavily braced with two by fours so that it cannot bulge or spread under the weight of the concrete. Pour the whole pond in one piece that is, all on the same day.

No finishing coat is needed, but it may be brushed with a cream-thick mixture of cement and water as soon as the mold is taken off. This pond will be waterproof and Winterproof.

Concrete Tubs

Concrete tubs (that is, small saucer ponds), five or six feet across, are no task to make. Build them the same as the temporary pond, but make them thicker if you want them to be permanent. If they are three inches thick they are not likely to crack and reinforcing is hardly necessary.

The material for a five and one-half foot bowl, a foot deep and an inch thick, will cost very little. It will take a man four hours to do the work if he hurries. In my opinion, this is close to the ideal for a small pond. If it does crack over Winter, it is so easy to rebuild that there is nothing to worry about. For such a pond all you need is a bag of cement, two

cubic feet of sand, and three cubic feet of crushed rock. When you see how easy it is to build such a pool, you will blame yourself for going without Waterlilies all these years.

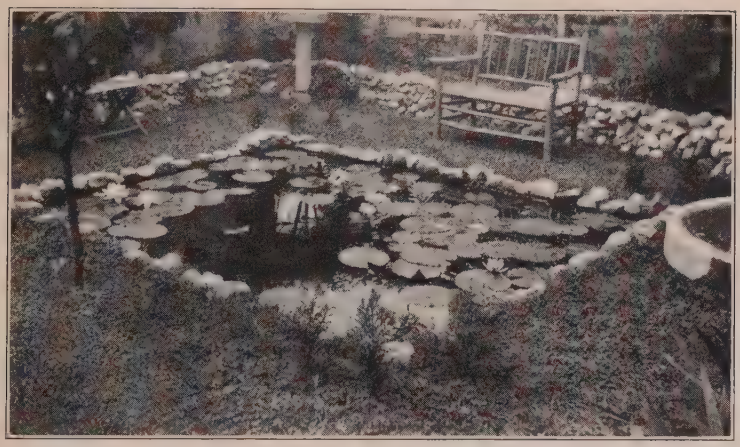
Larger Ponds

For larger ponds, the same method as recommended for the permanent pool is satisfactory, merely building thicker. Six inches is thick enough for a thirty-foot pool. Such a pool may be made oval, or, in fact, any shape without corners or sharp turns. Where corners are necessary simply build heavier and use more steel.

The ponds mentioned are all poured in one piece, but there are many other ways of building. The other methods, however, nearly always result in a job that leaks, which may not be serious where there is an ample water supply, but where all the water ticks through a meter, or where one has to depend on the rain, that is different, and one had better try to make the pond leakproof at the beginning.

A wooden mallet is very handy for tamping the concrete in building a pond. Tamp until all cracks and holes disappear

It cost $1.25 to build this pond and required four hours of work. It is 5½ feet across, 12 inches deep, and the concrete is 1 inch thick



This illustration of a pool in Indianapolis, Ind., shows eight Waterlilies in bloom. The owner must have felt amply repaid for such wonderful response to his care

and the whole surface looks wet and sticky, and it is a good plan to wet up some pure cement with enough water to make it like thick paint and brush it all over the surface with a broom, thus making doubly sure that your work is waterproof.

Chapter IV

VARIETIES OF WATERLILIES (*Nymphaeas*)

TROPICAL DAY BLOOMERS

Nymphaea capensis or Cape Waterlily. Blue; fragrant.

N. capensis castaliaflora. Pink; fragrant.

N. capensis zanzibariensis or Zanzibar Waterlily.
Red, lavender-pink, blue-purple; fragrant.

N. caerulea and hybrids with capanesis type.
Blue Beauty. Sky blue.
Pennsylvania. Sky blue.

N. ovalifolia and hybrids with capanesis type.
Mrs. Edwards Whitaker. Giant light blue.
Mrs. George H. Pring. Dazzling white giant.
General Pershing. Giant light pink.

N. gracilis and hybrids with capensis type.
rubra. Orchid-pink.
rosea. Pure pink.
purpurea or Wm. Stone. Sky blue.
carnea. Orchid color.
Mrs. C. W. Ward. Glorified magenta; giant.
Stella Gurney. Pure pink.

N. micrantha hybrids with caerulea, capensis and gracilis—mostly medium-sized.
Panama-Pacific. Purple.
Mrs. Woodrow Wilson. Pale blue.
August Koch. Lavender-blue.
Dauben. Pale blue; small.
Mrs. Robert Sawyer. Lavender-red.
Blue Bird. Pure blue.

Night-blooming Nymphaea Juno, taken at 11 a.m. as flowers were beginning to close

NIGHT BLOOMERS

Nymphaea Lotus or White Egyptian Lotus. White.
N. lotus dentata or Sierra Leone Waterlily. White.
N. rubra rosea and hybrids with dentata.
- Juno. White.
- Minerva. White.
- Jubilee. Pink.
- O'Mara. Rose.
- George Huster. Deep red.
- Kew. Light pink.
- Dean. Light pink.
- Sturtevant. Rose.
- Frank Trelease. Brick red.
- Devonshire. Deep rose..
- And others.

HARDY WATERLILIES

Nymphaea odorata or American Waterlily. White, fragrant.

N. tuberosa or Magnolia Waterlily. White.

N. mexicana or Yellow Mexican Waterlily. Yellow. And hybrids.

Nymphaea tetrogana or Pygmy Waterlily. White.

N. alba or European White Waterlily. White.

N. rubra or European Red Waterlily. Red. And hybrids.

Nymphaea James Hudson. An exceedingly handsome variety of French origin. Color is red with a striking reflection of mauve

Rose Magnolia Nymphaea (*N. tuberosa rosea*). Flowers of an exquisite shade of pink, four to five inches across

HARDY HYBRIDS

With odorata roots

Nymphaea Helen Fowler. Pink, fragrant.
N. W. B. Shaw. Pink, fragrant.
N. Pink Opal. Pink, fragrant.
N. Rose Arey. Deep rose; fragrant.
N. Venusta. Deep rose; fragrant.

With tuberosa roots

Nymphaea tuberosa carnea. Pink.
N. Rose Magnolia. Deep pink.
N. Richardson. Very double white.
N. Glory of Temple Surlot. Very double, pink.

With marliac roots

Nymphaea Glory. Very prolific red; best Waterlily there is.

HARDY HYBRIDS—Continued

N. Morning Glory. Free, pinkish white.
N. Flesh Marliac. Free, pink.
N. Rose Marliac. Free, rose-pink.
N. White Marliac. White.
N. Hermine. Very free, white.
N. Yellow Marliac. Good yellow.
N. James Brydon. Watermelon red.
N. Vesuve. Free, deep red.
N. Escarboucle. Free, deep red.
N. Laydeker fulgens. Free, deep red.
N. Wm. Falconer. Deep red.
N. atropurpurea. Free, deep mahogany.
N. chrysantha. Orange.
N. Comanche. Amber.
N. solfatare. Very light orange.
N. Sioux. Pink and orange.
N. Yellow Pygmy. Dwarf yellow.
N. Gladstone. Good white.

The tropical day-blooming Waterlilies are all satisfactory and free blooming. They come in all colors but yellow.

Nature made all these varieties pretty good, but the gardeners were such a meddlesome crew, they straightway started in to mix the breed, as it were, and produced some wonderful hybrids. They thought they were putting something over on Mother Nature by improving upon her work, but she smiled indulgently, for she knew that the gardeners, too, were part of her plan.

The Capensis group are all of about the same shape, fragrance and size, though Castalia has a reputation for size, while purple Zanzibar may run a trifle small. Every plant in the Capensis group is excellent, for either small tubs or large ponds. They will thrive in poorer surroundings than any Waterlily except the Caerulea, and they have a wonderful fragrance. Nature made this group too good to give the plant breeder much of a chance; it wasn't fair.

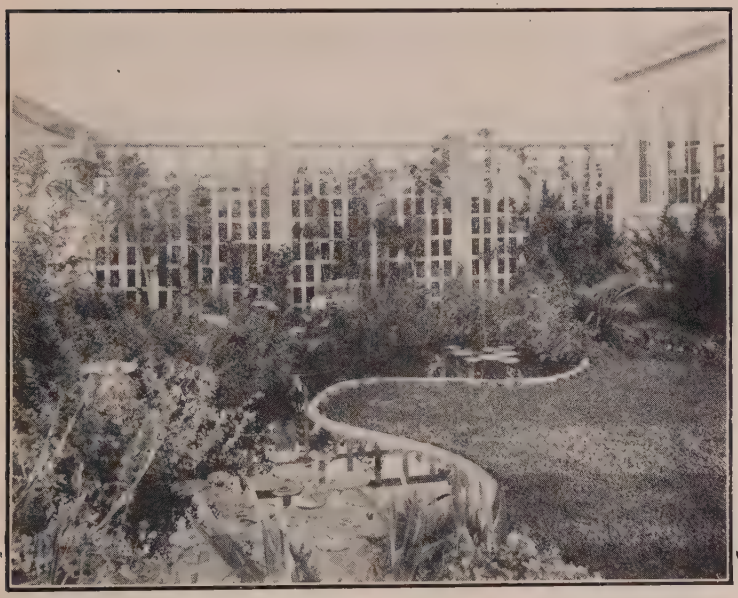
A tub garden and rockery of no mean pretensions is this. The photograph comes to us from Independence, O., and is conclusive evidence of the genius of the constructor in getting naturalistic effects not only in the garden itself, but in its captivating surroundings

The Purple Zanzibar is an exceedingly lovely flower with purplish-black sepals and very deep indigo petals. Unfortunately, it is always scarce as it is a troublesome plant to propagate. Its bulbs are rather weak producers and it does not come true from seed. All the other Capensis grow readily from bulbs or seeds.

Next comes Caerulea, an Egyptian, sometimes called Blue Lotus. Its flowers are pale blue and have pointed petals. The plant is only medium-sized. If it were the only Waterlily one had, it would be loved, but comparison is rather unfair to it. Caerulea is unusually resistant to poor conditions. It grows readily from seeds or bulbs.

The real value of Caerulea is not in itself but in its hybrids with the Capensis group. This cross occurs readily either way and always gives about the same result—a plant about

Nymphaea Goliath, a variety from Marliac, of unusual size and rich coloring



An excellent example of careful planning is shown above. The photograph was taken at Santa Maria, Cal., some four months after the planting. Paul's Scarlet Climber graces the trellis at rear and at left may be noted a happy planting of Mimulus (Monkeyflower) and Bamboo

half way between the two kinds, but larger. Save seed of either Caerulea or Capensis, if they grow side by side, and you will get some seedlings that are identical with the varieties called Pennsylvania or Blue Beauty (Pulcherrima). There will be just a little variation in these hybrids, but not much.

Pennsylvania is sky-blue, fragrant and quite large and is one of the best. It grows freely from bulbs but produces very little seed.

Ovalifolia is just a Caerulea that tried to be stylish. Its petals are more slender than Caerulea and nearly white. If you like the delicate blue of skim milk, you will rave over its rare beauty. It grows to quite large size and is of graceful

form. Where Ovalifolia excels is as a parent of the elite hybrids. It is the parent of Mrs. Edwards Whitaker, General Pershing and Mrs. George H. Pring.

Whitaker is an elegant flower, a brilliant light blue in color and of satin finish. It is one of the largest Waterlilies and stays open the longest, and has been known to bear fourteen-inch blooms. It seeds freely, but the seedlings, as a whole, are ordinary. Whitaker has a leaf almost like Pennsylvania, but the tips of the cleft are longer and the leaf is more oval and darker in color.

General Pershing is a lovely light pink of pure color tone and of large size. The leaf is spotted red underneath and blotched mahogany above.

Mrs. George H. Pring is the best white on the market, a large, strong grower, and with wonderfully fine white flowers. It seeds sparingly, some of the seeds coming true. The leaves are spotted black beneath and mahogany above.

Ovalifolia makes pretty hybrids when crossed with purple Zanzibar. These resemble Pennsylvania but the color is more even and the texture more satiny. Ovalifolia is a peculiar parent, in that it does not transmit its lovely slender petals to its children, but, on the other hand, it endows them with a clearness of color which it does not itself possess.

Gracilis is a cheap-looking, small flowering white bloom from our Mexican border. It hybridizes freely with Capensis varieties and its offspring are of clear color and gracefully star-shaped. Generally they are only medium-sized, but for style and delicate beauty, they are in the first rank. All of the gracilis seed sparingly.

Last, and in size least, is Micrantha, the viviparous or leaf-propagating Waterlily. It has a little gray-blue flower that one wouldn't look at, but the leaf is unique. Each leaf has a bud in the center and this bud is capable of growing into a new plant. It is quite a curiosity and a very easy propa-

This beautiful picture, from a New York State garden, shows a happy combination of Waterlily pool and flower garden. The owner of those restful looking chairs is certainly to be envied

gator. Micrantha is off the market but its hybrids are here to stay. These hybrids are all leaf propagators. They probably combine the blood of all the tropical day bloomers mentioned in the list, making them very interesting parents to grow seedlings from. Dauben and Mrs. Woodrow Wilson are shy seeders, but the others are prolific. Hardly any two seedlings come alike, but they are all so pretty that they never disappoint. A pod of Panama-Pacific seed is a regular box of surprises. It will cross with any of the tropical day bloomers except Dauben, Mrs. Woodrow Wilson and August Koch, and it seeds freely.

Pollenizing or Cross-breeding

To pollenize or cross-breed a Waterlily, find a flower that has opened for the first time on that day. You can judge this

Natural Waterlily pond. This already very beautiful spot is made more attractive with the splendidly colored Primula pulverulenta tastefully planted along the water's edge

by the nectarlike liquor in the center of the flower. The flower must be on a large, strong and well-established plant, or it may refuse to set any seed. Then find a flower that has opened before; it will be dry in the center. With your fingers pinch out some of the pollen-covered stamens and drop them into the nectar of the first flower. If this is done outdoors, put a piece of cheesecloth over the treated flower to keep the dwarf bees from bringing in the wrong kind of pollen. Unless you are lucky, the pod from this flower will rot within a week and you will get no seed; but if the pod stays firm, tie a piece of cheesecloth around it to catch the seeds when the pod breaks. Tropical seeds keep best in the dry state. Hardy seeds must be kept in water.

To grow the seed, scatter it on ordinary topsoil in a shallow pot or box, sprinkle some sand over it to hold the seed down and sink in a tank or tub under a couple of inches of water. Or plant on an inch layer of soil in the bottom of a dishpan or even a soup bowl of water. In a greenhouse, plant at any time, but in a sunny window plant in March. They like a temperature of 70 to 90 degrees; if the temperature is too low, they will not die but will patiently wait for warmer weather.

The Capensis varieties often bloom in ninety days from seed, but most kinds take about five months.

Do not be afraid to experiment. We need deeper reds in the tropical day bloomers, some giant purples and some extra double tropicals; and, of course, some varieties that never close would be good.

It is doubtful if tropical day bloomers and night bloomers will ever cross with each other or with hardy varieties. Pring has tried innumerable experiments and has proven beyond much doubt that it cannot be done.

In hybridizing the hardy sorts, Marliac did not leave much undone. Marliac was a Frenchman and a plant wizard. He

Yellow Marliac Nymphaea (*N. marliacea chromatella*). Bright canary-yellow with deep yellow stamens

crossed and recrossed the various hardy varieties back and forth until they hardly knew themselves. In his Glory you can find the signature of almost every hardy variety. Practically all of his best kinds are due to his efforts. He kept his methods secret and no one else has been able to make the crosses that he is supposed to have made. His secret died with him, but we do thank him for giving us the truly marvelous flowers.

Most gardeners must select their Waterlilies from a catalog. There will be many varieties listed which may not be mentioned here, and in some cases different names may be used. But in the long run, it is quite satisfactory to buy ac-

cording to description and not worry unduly over names. Dealers are usually careful in giving exact descriptions.

The odorata and tuberosa types are rather rampant growers and may crowd out weaker varieties if allowed to run unconfined. They are less free blooming than the Marliac type, but all have good colors and the Odoratas are all fragrant, whereas very few of the Marliacs are fragrant.

Giant Plants

Hardy Waterlilies will reach full size in a cubic foot of

Nymphaea Mrs. Edwards Whitaker, one of the very finest of the blue Waterlilies and of great size. Center bloom 11⅝ inches in diameter

soil, as a rule. The largest of the tropical varieties, however, require a box of soil a yard square and a foot or more in depth if they are to reach full size. This applies to all the night bloomers andto the largest day bloomers, such as Mrs. Edwards Whitaker, Pennsylvania, Mrs. C. W. Ward, General Pershing, Mrs. George H. Pring, Capensis and Ovalifolia, which will result in plants ten to fiftten feet acrosss and flowers as large as dinner plates. Such plants are rather large for the average back yard pool, but two or three can be planted near the center of a twelve-foot pool and get along pretty well. Giant plants are so spectacular and so wonderful that they should be grown wherever possible.

To get the best results with night bloomers, they should be given the space mentioned, or very near to it, although a five-foot pool and two cubic feet of soil will answer.

All of the day bloomers are able to fit whatever size containers they are put in. A Zanzibar Waterlily plant will adapt itself as well to a fifteen inch dishpan as to a fifteen foot pond.

Chapter V

SACRED LOTUS (*Nelumbium*)

THE Lotus is truly the aristocrat of the whole Waterlily group. A Lotus pond is a most striking sight. The leaves of the plant are concave and shield-like and are carried well above the water. The huge flowers are often borne on stems as high as five feet above the water. The flowers are produced in shades of yellow, pink, red and white, single and double. All are perfectly hardy.

In growing Lotus, remember that although perfectly hardy, they want all the heat they can get while they are growing. Especially is this true while new plants are becoming established. Once established, the Lotus is hard to kill, but new plants are delicate and many of them fail. Either potted plants or tubers should be planted just on top of the ground in very shallow water. If a coldframe can be put over them to hold the sun's heat, so much the better. The soil used should be quite rich. In our latitude potted plants should not be put out until June, while tubers are best moved the latter part of May. Where a greenhouse is available, Lotus plants or tubers are best started inside, preferably at a temperature of about 80 degrees. This will produce thrifty plants to put out late in June. This method makes success quite certain.

In starting the Lotus out of doors, steel yourself against failure, and if the first plants die, try again. Potted plants or runners, carefully dug, may be planted out of doors up to

This marvelously beautiful picture of a pool at Marion, Ind., represents the very acme of artistry in its conception and setting. It seems hardly possible that man could assist Nature to the extent of producing such a masterpiece

the middle of July, and if given good conditions, will become established and be ready for Winter.

Lotus seeds grow easily if they are available. File a hole in the seed coat and start the seed in warm water in late May and plant out in a warm, rich, shallow pond in June. They may reach blooming size by September, but that is rare.

Lotus plants are such rapid spreaders that they must be confined if there are any Waterlilies that they can crowd out. This may be done by planting them in large wooden boxes, at least a yard square and a foot deep. A splendid way to grow them is in small concrete bowl ponds, five or six feet

Nelumbium nucifera (Hindu Lotus). A free flowering variety bearing exquisite rose-colored flowers

across. Put about a foot of good soil and manure in the bowl and plant the Lotus in six inches of water, and it will do wonders.

Do not pass up Lotus just because they are hard to start, for they are worth all the bother and expense many times over.

Common Varieties

Nelumbian nucifera (Hindu Lotus). Pink.
N. lutea (American Lotus). Yellow.
N. nucifera alba grandiflora (Empress). White.
pekinensis rubra plena (Red Peking). Double red.
alba plena (Shiroman). Double white.
pekinensis rosea. Double pink.
N. flavescens. Cream; very prolific.

The double varieties are more free blooming than the single. All are perfectly hardy if they are favored with good growing conditions during the Summer.

Lotus in the Greenhouse

Where there is greenhouse space available, Lotus will do wonders under glass. Plant them in March, if possible, in warm tanks from three to five feet square. Use rich soil and add more soil and manure occasionally during the season. The plants will start blooming in early June and will produce some mammoth leaves and blossoms. This method of growing the Lotus offers wonderful opportunities for hybridizing, for they cross quite readily.

Under glass, spray the leaves with water every day to keep down red spider.

Greenhouse Lotus will go dormant during the Winter months, regardless of temperature.

Chapter VI

VICTORIAS

VICTORIAS are easier to grow than any of the tropical Nymphaeas. All they ask is plenty of heat, and the cruziana variety is not so particular about that.

The important point is a good supply of seed. As the amount of Victoria seed in America is always limited, it is best to order from some reliable grower the Summer before. The German seedsmen can generally supply good seed in any reasonable amount.

Starting the Seed

Keep the seed in water at a temperature of about 60 degrees until February; then plant in flats or pots of any fairly rich topsoil and put in a tank with a temperature of 85 to 90 degrees for Victoria regia, and 70 to 80 degrees for V. cruziana.

The young plants will start coming in about six weeks. Transplant any time after they are up into five-inch pots of topsoil mixed with a little manure.

About twenty per cent germination may be counted on for regia, but cruziana is not so reliable.

Seeds that fail to come up in ten weeks may be stimulated by acidifying the soil they are in with a dilute acid, such as sulphuric, hydrochloric, or even vinegar. Give them a pretty good dose of it and they may start waking up in a few days.

A greenhouse pool, twelve feet across and a foot or more deep, will grow a nice Victoria plant to blooming and seed producing size. Of course, a thirty-foot pool, a yard deep

The enormous leaves of the Victoria floating upon the water, in company with Nymphaeas and bog plants. Victorias were first introduced into America in 1852

and steam heated, will grow a much larger plant, but that is hopelessly beyond the dreams of most of us. The summer climate of Cleveland is a little cold for a Victoria, but even there a cruziana plant can generally be bloomed out of doors. In any place south of Columbus, Ohio, however, it should be possible to grow either variety out of doors to perfection.

There is only one reason why Victorias have not become common, and that is because the dealers have been afraid of them. An idea prevailed that they were difficult and expensive to grow, and the idea took root.

Victoria seed can be grown in quantity on a plant in a fifteen-foot greenhouse pool, so that there need be no great scarcity of American-grown seed.

Fresh water shrimp will attack Victoria seedlings. To get rid of them, drain the tank, clean it and put in fresh water.

Chapter VII

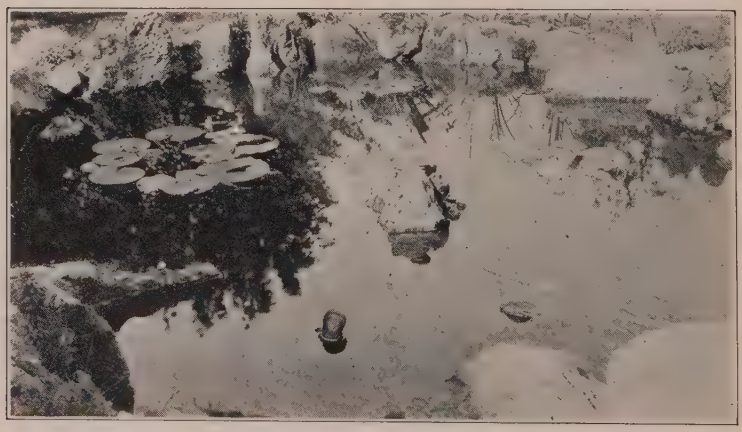
CULTURAL DIRECTIONS

Soil

THE best soil mixture for Waterlilies is three parts loam and one part rotted cow manure. Stable manure will do but, lacking this, bonemeal, bloodmeal or sheep manure will answer. In the greenhouse, use less manure (about one-tenth), and never use bone or bloodmeal.

Water

The best depth of water is six inches for Lotus and tropical Waterlilies and twelve inches for hardy Waterlilies. Where



This lovely view of a pool in Portland, Ore., shows that in spite of the cool climate, splendid results may be obtained by shallow water planting

Above is shown the clever handiwork of the students in the art classes at Maryland State Normal School, Towson, Md. The pool is eleven feet long and seven feet wide, and is planted with Water-hyacinths, Waterpoppies and several varieties of Nymphaeas. A planting of vines and shrubbery is contemplated, which will add to the naturalistic effect

necessary this depth may be reduced three or four inches without damage. This would make it possible to grow Waterlilies, even if your pond were only five inches deep, allowing a two-inch layer of soil and three inches of water. This would be an extreme case but perfectly practicable.

For deep water, from two to five feet, the native tuberosa and odorata are the only ones suitable. The fancy hardy varieties will all do well in two feet of water, excepting the dwarf varieties.

When a pond is newly filled, the water very often gets full of green scum and mossy algae and looks most unappetizing. This condition usually passes off and the water will clear up of its own accord. Clearing may be hastened by poisoning the algae with copper sulphate, using it at the rate of one-quarter ounce of copper sulphate to 1875 gallons or 250 cubic feet of water. This will not hurt plants or fish if (and this "if" is

a very important word) you do not overdo it and use too much. In hard water copper sulphate is not very effective and a greater amount should be used. However, do not use it unless you have to; it is risky.

Insect Pests

Plant lice will be the worst pest to contend with. Spray them with Black Leaf 40, one teaspoonful to a gallon of water. After two or three sprayings they usually disappear. This treatment is safe for Lotus and Victorias, as well as for Nymphaeas.

Leaf cutters can be held in check where they are bad, by dusting leaves with a very thin coating of Slug Shot. Leaf borer on Lotus can be checked in the same way.

It does not matter much whether you put your soil in the bottom of a pool or in boxes, so long as the depth is all right. In a very deep pond, boxes may be set up on stones or on legs to get the right depth.

As to shade, all Waterlilies prefer full exposure to the sun, but they will do well in half-shade; it should not be much over half, however.

Chapter VIII

COMMERCIAL POSSIBILITIES

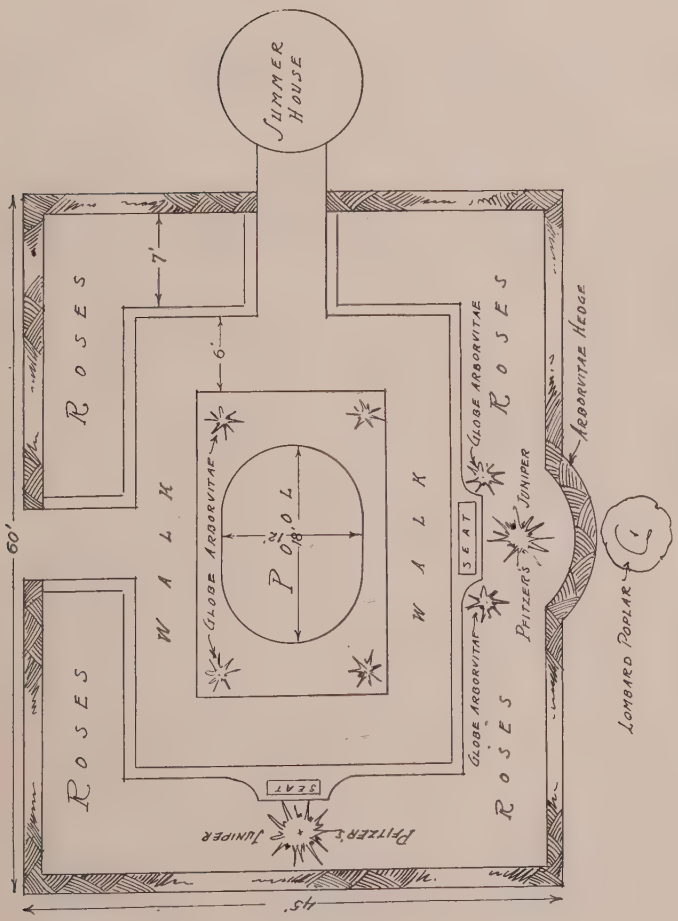
THE water garden trade in America amounts to about one hundred thousand dollars a year. It could easily be increased about tenfold by advertising, but right here is the big obstacle: At present the supply of hardy Waterlilies is barely able to meet the demand. Obviously, the thing to do is to raise more roots. Any farmer who can build large shallow ponds, safe from flood damage, can grow hardy Waterlilies and Lotus. So far this has proven a profitable sort of farming for the few who are in it. There are very few people in the country who are growing hardy Waterlilies with any very serious intent, but there is room and actual need for a larger number.

The choice of varieties is a matter of paramount importance. In general, the Marliac varieties are the more valuable, especially the medium-priced and high-priced ones. At present, though, almost anything is salable. Generally the wholesale prices are one-third of the retail prices.

When dealers dig a root to sell, they generally cut the eyes or plant buds off the root for stock. This does not damage the root. These eyes are planted closely in shallow water and later transplanted about a foot apart. With careful nursing a good percentage of them will make salable plants for the next year.

In a rich pond the roots generally branch out into several heads in the course of the year. These heads may be broken apart and sold or replanted. If a plant really likes its location, it may multiply itself ten times in a year.

These views from a garden in Rochester, N. Y., show a keen conception of the beautiful. The diagram on opposite page gives the arrangement in detail, including the shrubbery planting, which adds greatly to the charming creation



See opposite page for views of this planting plan as actually worked out

View in a Waterlily house, showing water and bog plants. A large specimen of Cyperus papyrus may be seen in the background. The tank is, of course, heated and the temperature is kept above 70 deg. F.

Muskrats are the worst enemy of the commercial grower, and should be exterminated for they are very destructive.

The growing of tropical Waterlilies is for the greenhouse owner only, who is able to retail them. There is at present little chance of wholesaling them except in special cases.

The bulbs are best carried over Winter in wet sand in rat-proof and nearly airtight cans at a temperature of about 70 degrees F. At this time the tanks may be used for growing tropical fish and aquarium plants, for which there is a large demand. Scarce varieties of tropical Waterlilies may be grown and propagated all Winter with profit. Late March is early enough to plant the main stock of bulbs. The bulbs are planted in thumbpots or flats of sand or loam

—they are not particular—and put in tanks of shallow water warmed to between 70 and 90 degrees. They will throw young plants in about two weeks' time. These plants are pulled off the bulb as soon as they have two or three floating leaves. The bulbs are replanted in fresh soil and the plants may be put in five-inch pots. A good potting mixture is clay subsoil to which about one-tenth its bulk of well-rotted manure is added. This mixture sounds rather poor, but in a hot tank it acts a little better than topsoil. The plants grow strong enough to ship in about three weeks. After six weeks they are pretty sure to exhaust the soil and form another bulb unless shifted to a larger pot as soon as they get root bound.

Capensis and caerulea varieties and the night bloomers may be grown from seed sown in early March. In growing seedlings, always count on losing about two-thirds of them so you will not be disappointed. However, plant plenty of seed and "don't put all your eggs in one basket," which, of course, means try your seedlings in at least four or five different tanks and kinds of soil.

Lotus seeds sown in April will make nice plants by shipping season.

Plant lice and leaf cutters must be kept down by fumigating twice a week with nicotine or by some other method, such as the use of sprays and Slug Shot.

There is just as ready a sale for other aquatic plants as there is for Waterlilies. They bring lower prices but there is a large market for them.

Propagating Fancy Varieties

The fancy varieties of Lotus are very easy to propagate in quantity in warm tanks in the greenhouse. Here is the method:

Take a greenhouse flat (a box about 15 x 20 x 4 inches) and knock off the sides. Then nail the sides back again in the same position but higher up, leaving a half-inch crack

along the bottom of the flat. Plant a Lotus root in this flat, and every time it sticks its nose through the crack, "knife it." To be explicit, some of the Lotus runners will grow through the crack, and when they are about two feet long, cut off the terminal joint with a leaf and plant it in a five- or perhaps an eight-inch pot. Use a mixture of loam and manure in the flat and plant several roots in it while you are about it. By this method one flat will produce about fifty plants, so there need no longer be any scarcity of fancy Lotus.

Started at a high temperature, these Lotus should not be planted out before the middle of June.

Hardy Bamboos

It is always customary to mention hardy Bamboos in connection with water plants, although Bamboos are no more aquatic than field corn; they do fine under the same conditions. At present they are very scarce and almost off the market, but the demand is large. Since they are easy to grow and multiply rapidly, there would be a lot of money in a Bam-

A quiet, restful grouping of harmonizing plants serves as a frame for this well designed pool with its beautiful aquatic blooms

boo farm. The green-leaved varieties are preferable to the variegated ones.

Propagating Viviparous Waterlilies

In propagating viviparous Waterlilies (those that develop new plants from the leaves), pick off full-grown leaves that have good buds in the center and let them float on the water until the young plant forms and the leaf rots or turns yellow.

Most of the viviparous varieties will propagate from bulbs also, but not very readily.

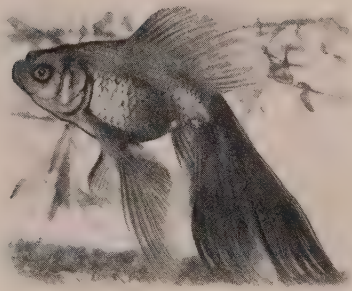
Caerulea and Blue Zanzibar will often refuse to form bulbs in five-inch pots because they overgrow. Try them in two-inch pots and they nearly always form bulbs—small ones, but sound and vigorous.

Part II

GOLDFISH

By

Edwin H. Perkins



Foreword

THE interest in keeping fish in the home over Winter, and in Lily pools in Summer, has become so great as to cause this work to be written, which the author trusts will increase the knowledge of the embryo fish culturist and provide the more advanced amateur information heretofore hard to obtain.

With this object in view, every effort has been made to present the subject in a friendly manner. The information has been obtained by hard knocks, failures, and much traveling. Valuable assistance has been given by wholesale breeders, to whom my thanks are extended.

EDWIN H. PERKINS.

Chapter I

THE HOME AQUARIUM AND ITS MANAGEMENT

BY home aquarium we mean a receptacle, be it either a wooden tank of some water-resisting wood, such as Cypress; or one of all glass construction, like the jars used for battery cells; or a metal-rimmed tank with glass sides and bottom of slate; or, again, the concrete-formed aquarium, properly planted and stocked with its complement of the fish most liked by the enthusiast.

To my mind, the home aquarium should resemble a bit of Nature, transported from the bottom of a stream and encased in glass to make it enjoyable to the eye. For that reason, the so-called beautiful castles, carefully carved by some, and molded by others, are not desirable because of their artificial appearance. Can they compare with a few well-chosen stones from the bottom of your pet stream?

When one considers the expense, both initial cost and maintenance of a dog or cat with that of an aquarium, there is no reason why one should not have in his home a beautiful, although not expensive, aquarium. The home aquarium provides a soothing tonic for our tired nerves; the attraction offered by the graceful movements of fish and snails is an untiring pleasure; it is most economical when properly managed, and the management offers recreation and diversion. Fish foods cost next to nothing, and the other maintenance costs are more than taken care of by the enjoyment of the life in the aquarium.

Of the types mentioned, the most desirable is the metal-rimmed tank, and one of generous proportions should be provided. One of ten gallons capacity can be relied on to give satisfactory results, and one of even greater size is preferable. The round fish globe, now so generally used, is very unsatisfactory, since it offers such a small exposure to the air, and besides causing eye trouble to the fish, due to the refraction of bright light through them, one cannot help but feel sorry for the inhabitants, who seem to have no place to go. Added to this, we might say it is almost next to impossible to maintain a proper plant growth in them. With the proper tank at hand and the rigid application of the few principles which follow, your success will be assured.

The goldfish, contrary to universal belief, is hardy, and when one considers that their average life, under proper con-

An attractive home aquarium

ditions, is about sixteen years, I feel that my statement is correct. On the other hand, repeated reports of failure and wholesale deaths have come to my attention and that of others. This condition at times has become so serious that lots of aspirants have lost a desire to keep fish because they believed goldfish were so delicate and demanded so much care. Despite this opinion, it can safely be said that goldfish survive under most severe conditions and neglect of the proper care of the aquarium.

Overcrowding is the most common cause of failure. The beginner invariably has a desire to keep more fish in his aquarium than can be properly sustained by its proportions. The balanced tank—by which is meant one in which sufficient plant life is provided to sustain a given amount of animal life—is the most simple and easily kept; and at the same time the greatest sufferer from this cause. An aquarium of the accepted oblong type of about ten gallon capacity, well planted and provided with at least two hours of sunshine each day, will sustain in a healthy condition only two five-inch fish. The rule for determining the number of fish one can keep in an aquarium is to provide every inch of fish, not counting tails, with one gallon of water. The writer has never known success to follow a deviation from this well-known rule. Some fanciers permit only one inch of fish to two gallons of water, but this is extreme. And let me say here that while the ten-gallon tank is taken as the standard, a large number of fish can be kept alive in a small quantity of water by frequently changing it, but this soon becomes tiresome; the fish, because of the frequent changes of water, become sick, and we look around for an easier way to keep them.

If we understand the fundamental principle of balancing a tank, we soon learn that it is just as easy to balance a small one as it is a large one. First let us see what, beside food, is required to keep the fish alive, and we learn it is water

full of oxygen, which the fish absorb to sustain life. If we were to permit fish to stay in water, with no means of replacing the oxygen as it is absorbed, our pets would live but a short time.

Some means must be found for replacing the oxygen, and one way, where a large number of fish are kept in a small quantity of water, is to draw off about one-quarter of the water content and pour it back slowly from a slight elevation. In this way oxygen is collected by the water while falling, and even the small quantity collected in this way adds much to the comfort of the fish.

Oxygen is supplied in the balanced aquarium, not mechanically, but by proper plant life which, when exposed to strong daylight, throws off a quantity of its waste product—oxygen—and these same plants in turn absorb the carbon dioxide thrown off by the fish. Snails may be added, which will consume the decaying vegetation and act as window washers in constantly going up and down the sides of the aquarium, thus cleaning it of the scum—known as algae—which forms on the glass.

Now if you want to keep, say, only two or three small fish, and their bodies measure about one inch each, one of the small inexpensive tanks of about three gallons capacity can be used by planting in it a sufficient number of the plants mentioned later, to throw off oxygen enough to maintain life in the fish, and you cannot make a mistake in planting too many. It is better to treat fish this way rather than overcrowd, for fish in poor condition from overcrowding are seldom brought to their prime. When the fish come to the top of the water in daylight and gurgle air and water, it is safe to say your tank is overstocked. The fish, feeling the water lacking in oxygen, goes to the surface and regurgitates the water in its endeavor to oxygenate it, in much the same manner as you would by blowing a stream of oxygen bubbles through it. A partial change of water is but a temporary

relief; you must either increase the size of your tank or reduce the number or size of its inhabitants. Do not feel alarmed if your fish seek resting places near the top of the water in the evening, for it is natural for them to do this.

Overfeeding. Much trouble is caused by the food and feeding methods. It is often said, "Many kill their fish through kindness—they feed too often." A safe rule for feeding fish, other than young growing stock, is never give them more food than will be consumed in about twenty minutes. In addition to the time method of feeding, it is well to know that fish in cold water require less food than if kept in warm water. In the Fall plant life loses its leaves, turns brown and is known technically as dormant. Fish, when kept in the same condition as plants, do not become dormant but use the Fall and Winter, when the temperature of water is naturally low, as their resting period. When water runs at from 45 to 50 degrees, they will do well with feeding twice each week, and 40 degrees is the minimum temperature which fish of the less hardy varieties are able to safely stand. The common fish will stand a temperature of about 33 degrees and requires feeding only once in 10 days. The best ways known to feed fish are to place the food in small china receptacles or in floating feeding rings with a sort of catch pan suspended, so that all unconsumed particles of food can be lifted after feeding. While it is claimed fish die from overfeeding, I share the opinion with several other fanciers that this is untrue. It is my belief the trouble comes from the fermentation of food left in the aquarium.

A gentleman of the writer's acquaintance recently tried an experiment in feeding. He placed a three-inch fish in a five-gallon tank of water, which was fed a heaping tablespoonful of a commercial cereal food known for its high protein and oil content. After two months, this fish (with no change of water) was found to be living over a mass of fish

food—which did not ferment—yet none of the troubles, such as indigestion and fungus, appeared. The fish made considerably more growth than a like-sized fish tried under the same conditions in a like receptacle, but given different food and only in minute quantities.

Another acquaintance, a grower of Telescopes and Orandos (an enterprising orchidist who raises fish to keep down the growth of mosquito larvae), feeds boiled oatmeal in fair quantities. At times his work calls him to places distant from his feeding receptacle and consequently a considerable time elapses between the time of placing and lifting the food, yet no diseases, other than those brought to his tanks by outside fish, have ever appeared.

To show the extremes possible in feeding, this same man has bred most excellent Telescopes from a pair of fish presented to him by a lady who thought fish obtained their food from the water in which they were kept and, consequently, had not fed the fish in two years.

The variation in water is another of the so-called stumbling blocks to the aquarist which is easily remedied. When the proper water conditions have once been established in an aquarium it is seldom necessary to change it, except for accidental causes, some of which are the unknown death of scavengers or fish or the development of disease. Fanciers replant about once each year in order to thin out plants which have made too much growth. The siphoning of refuse from the bottom, about once each week, and the addition of water to make up that lost by evaporation is all that is necessary.

Water for the purpose can be drawn from any good water supply, care, however, must be used with raw tap water. It is better to ripen this water by letting it stand a full day. In this way it has an opportunity not only to throw off some of its oxygen, but also to obtain the right temperature.

If time presses and you are required to use raw tap water, the addition of about two ounces of salt to each ten gallons

of water will improve it. The salt made for bath purposes, known as sea salt, is the best; not easy running or table salt. Well water is not as good as spring water. Spring water usually bubbles out of the ground, and the slight aeration obtained in this manner improves it. Distilled water is not desirable because of its lack of minerals. On the other hand, some spring, well, and even river water, have such a heavy content of sulphur, lime and other minerals as to be entirely unfit for the purpose.

City water is satisfactory, except when it has been too highly purified, a condition never encountered by the writer. However, in the Spring city water must be watched closely, because the water departments use copper sulphate in the lakes at this time to keep down plant life.

The absorption of salts from water by both plants and fish requires that we occasionally add them, otherwise a chemical depletion in the water would exist. For this purpose, a mixture of about three parts sea salt and one part epsom salts should be used. A substantial pinch to about ten gallons of water should be used each week. You will be surprised at the way in which the fish take to this salt.

While plants do best when fertilized with an acid, this, together with the acidity caused by the decomposition of plants, causes a condition easily overcome by placing a small lump of plaster of paris in your tank. When an acid condition takes place this lump of alkali neutralizes it. The rapidity with which the plaster of paris dissolves denotes the condition of the water concerning acidity.

Green water, while not pleasant to look at, is certainly the most beneficial for your fish. When the water is green, by transmitted light, you will find enormous quantities of microscopic plant life in it. It is caused by too much direct sunlight. Green water may be cleared chemically by adding about five drops of a saturated solution of potassium permanganate to each ten gallons of water. The use of this

solution, which acts as a disinfectant and is beneficial to your fish, will cause the water to turn to a pale lavender and gradually clear up.

The best possible light in which to place an aquarium is one where about two hours' direct sunlight each day can be obtained. This should be shaded in the hot Summer months from the direct rays of the sun. In order to properly do their work, plants require light. An aquarium without light might just as well be without plants. Oxygen, the waste product of plant life, is required in a balanced aquarium to replace the oxygen used by fish. Plants, however, need the by-product of fish, carbon dioxide, to sustain themselves. An aquarium stocked with fish at the rate of one inch of fish per gallon of water and planted with a sufficient number of oxygenating plants, provided with a few scavengers, and given proper light, is known as a balanced aquarium.

The kinds of plants suitable for this purpose, in their relative useful order are: First, Sagittaria, either of the giant or dwarf varieties. Sagittaria gigantea is a broad-leaved stocky plant, with an average height of from ten to fifteen inches and has the appearance of the top of an onion plant. Once established, it stands much abuse. About two specimens per ten gallons of water is considered ideal, together with at least four of the variety known as Sagittaria natans, which is much like the former, but of more moderate size and multiplies with exceeding rapidity. Contrary to the ordinary rules of plant life, both of these plants grow the entire year and supply much oxygen under all conditions.

Vallisneria spiralis, also known as Eelgrass, Tapegrass, and Channel Grass, is another plant much like Sagittaria, having very long, graceful leaves of an even breadth for their entire length. The leaves are a light green, much lighter than Sagittaria, and have the peculiar property of growing in an almost straight line from the point at which they branch from the crown of the plant to the top of the water, where the

Left, Vallisneria, an artistic as well as useful plant. The runners by which the plant increases do not grow up the plant, as shown in this illustration, but spread out on the floor of the aquarium, about two inches apart. *Right,* Sagittaria gigantea, not as graceful as other plants but the best oxygenator of all

larger leaves float most gracefully. Artistically, it is without an equal in the home aquarium. About a dozen specimens will soon cover the floor of a ten-gallon aquarium if given only a slight chance. It multiplies from runners, which lie close to the bottom, not even needing pushing in the sand.

Anacharis, commonly called Ditch Moss, is in some places called a pest because of its rapid growth. It, unlike the other mentioned plants, does not require planting in the sand, but floats and sends its fernlike leaves, supported by tender green stems, all over the top of the water in a beautiful mass. The closeness of the leaves to each other depends on the proper amount of light. Since the plants grow an average of five to six feet, it is well to break off only the new, tender green shoots

Left, Ludwigia, also known as Swamp Loosestrife, a pretty plant but a very poor oxygenator; *right*, Anacharis canadensis, a plant which should be in every aquarium

and destroy the older or slightly discolored ones. While some writers prefer to plant Anacharis in bunches, it seems to me to grow better if permitted to float at random. Enough of it to cover the top of the water should be on hand at all times, for I have never known of a case where too much was provided, as it is an excellent oxygenator.

Cabomba, Ludwigia, Myriophyllum and many others do so poorly as to cause them to be used but rarely.

The proper way to plant all these is to cover the bottom of tanks or pools with about one inch of good, rich garden loam or peat moss, over which we place an inch of recleaned washed sand (not bank sand), and spread out the roots of the plants in much the same manner as you plant a tree. Cover to a depth sufficient to just cover the crowns of the plants. Remember, the leaves of aquatic plants should never become even partially dry. In order to avoid disturbing the roots after placing, it is well to pour water in a saucer placed on the bottom, rather than let the force of the water strike and stir up the sand.

Scavengers are the means depended on to remove offal and decomposition in the aquarium or pool. Scavengers in the form of snails do this work most effectively. The most beautiful of these is the Ramshorn or Coral Snail (Plonoabis corneus), because it is a most active worker and of very attractive appearance. It has become a great favorite. The Japanese Snail (Viviparus malleautus), is much larger than its red brother. They are long lived and grow to a great size. Many are kept for their peculiarity of giving birth to fully developed young.

The most despised of all, the Pond Snail (Physa), is now coming more and more into favor, since it is the most active and hardy of all snails, a prolific breeder and intrepid scavenger. More real good results from their use than from any other. Snails of other varieties, because of their short life or other good reasons, are best eliminated.

Chapter II

VARIETIES OF GOLDFISH

THE goldfish in which we are interested for aquariums and pools are members of the carp family of two principal root stocks. First, the European Goldfish (Carassius carassius), the branch which has at its head the common goldfish and a few of the lesser developed varieties; and, second, the highly developed Asiatic branch, known technically as Carassius auratus). While the first is the cheaper and the more universally used fish, specimens of the latter certainly make more ornamental fish. These are the fishes on which the Japanese and Chinese have made so many successful experiments in cross-breeding and have, by very select intensive breeding, established some definite varieties. The common fish has never developed any of the fancy form of its Oriental brother, although some breeders claim to have done so. There are two generally fixed colors in common goldfish, the red, with its metallic sheen from which the name goldfish seems to have originated; and the milky white, called Pearl. A combination of the two is very often found and fish of this color are eagerly sought by the amateur. The light bronze-colored fish, also known as silverfish, are not a distinct breed. These fish have not as yet attained their final color. The time of color development differs in different fish, some never attaining either of the prominent colors.

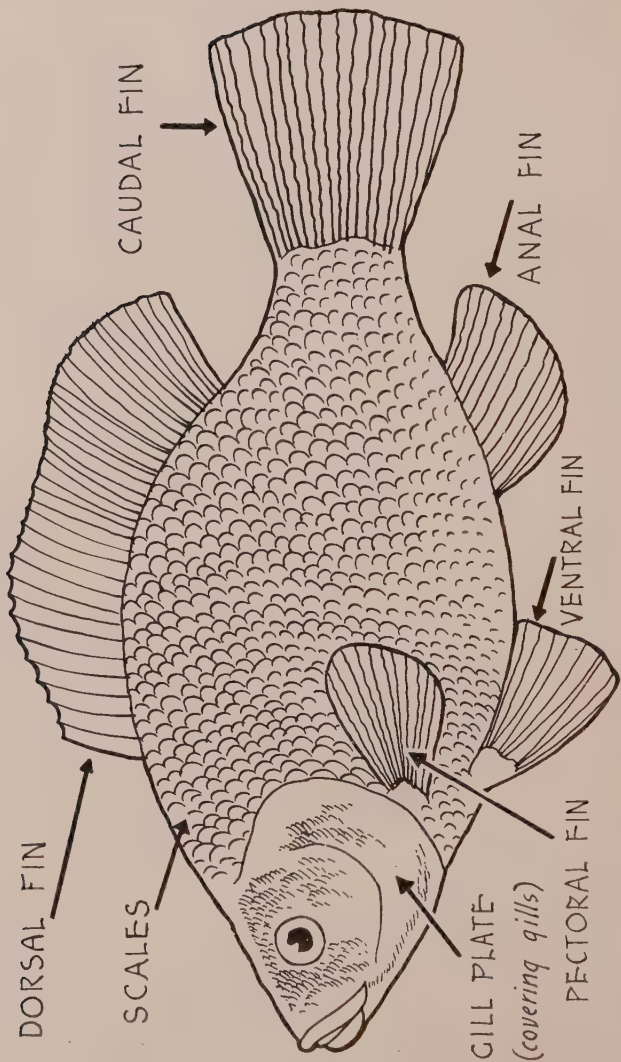
Fish are not only divided by color, but also divided into scaled and scaleless varieties. The scaled varieties are those

with very pronounced heavy scales. These, because of the protection afforded by these scales, are more hardy than the scaleless type, which are usually of Asiatic stock. While called scaleless, they do possess scales which, though scarcely visible to the eye, are apparent in good photographs slightly magnified. The colors of scaleless fish present a great variety, the more important being the blue and lavendar tints which are not found among scaled fish. Fish of this type seldom go through the first stage of coloring in which they are known as silverfish, but at two months of age develop some of their permanent colors, the first being white. At about three months a fair idea of their final coloring may be obtained. The colors from this time on intensify until the fish are about two years old, when their colors can be said to be at their maximum.

The illustration on the next page will help make clear the external anatomy of the goldfish. The parts mentioned should be well studied in order to better understand the development of the various varieties. The first important features are the gills, whose function it is to extract oxygen from the water. Water taken in at the mouth is forced under pressure through the gills, where the oxygen is extracted and absorbed by the blood vessels and carried to the body for purposes of maintenance. The gills of a fish out of water contract, for that reason it smothers; however, under water pressure they swell, much like a sponge.

The next is the dorsal fin, which is situated squarely on the back of the fish. In very well developed scaleless varieties this fin becomes so heavy that it droops over at its edges. The carriage of this fin usually tells the physical condition of a fish. When erect the fish is known to be in splendid condition; when closed down on the back trouble may be expected.

The pectoral fins are placed just behind the gills, at what might be called the breast of the fish.



External anatomy of the common goldfish

The ventral fins, used in retarding motion, also useful in maintaining a standing position, are situated just under the bladder.

The anal fin is situated directly behind the vent. Its function is much like the keel to a boat.

The caudal fin is the tail, of which we will speak later.

The number of fins differ in different varieties, some even showing an absence of the dorsal fin. The eye, and its development, differ in various varieties, and the whole body is susceptible to changes in different types under varying conditions. Many people labor under the impression that a common goldfish, stuffed with food in its early stages, can be developed into the short-bellied Japanese type. This, up to the present time, has not been accomplished. The tail or caudal fin has been the source of much experimentation; it has been lengthened, shortened, widened and divided. In the common fish it is short. An example of the elasticity of tail development is shown in the evolution of double or fantailed goldfish. First, the tail is caused to divide at about its center into two lower sections which spread out and cover the anal fin, When viewed from behind it presents the appearance of an inverted letter "Y."

In this form it is known as a tripod tail. Later development produced fish in which the tail was joined together for only a small space on the top, giving the appearance of two tails except for the small line of contact. This became known as the web tail. The next stage was a complete separation, having no point of contact other than at the body, when the fish became known as a double-tailed variety. Selective breeding has fairly well fixed these types, yet much reversion of type is found in fish as will also be found in other animals.

The common goldfish, the most hardy known, is chunky, of splendid body proportions, and has tough fins, fairly short. The stubby, scaleless head is flattened as is also the body. In this variety only one anal and one caudal fin are present.

The Comet, most graceful of aquarium fishes

Fish of this variety have been known to live out of water for twenty-four hours wrapped only in moist newspaper. For the novice attempting fish culture for the first time, this variety, while representing no real investment, will afford much pleasure and, with but a little food, reward him with a considerable crop of youngsters.

The easiest change possible to make in a fish is that of increasing the length of body and fins. When an increase in these have been accomplished another variety known as the Comet has been established. It is believed this variety came about by the crossing of the common fish with some Japanese stock. Much controversy concerning its origin has taken place, and we now learn the Japanese have renounced all credit for it. Its long body and fins, together with great tail length, make it one of the best pool varieties of fish where decorative effects are desired. While almost as hardy as the common variety, the lengthening of the body seems to have decreased their prolificity. Though they do not spawn so freely, they breed true to type and are very desirable.

A rare specimen of Japanese Veiltail Telescope

The Shubunkin—a transparently scaled common goldfish, the next variety in order, is somewhat smaller in fin development than the Comet. All the colors of the gorgeous Telescope are apparent in Shubunkins. The predominating color is blue, although brown, yellow, and a small amount of black are often found in them. The Japanese have taken kindly to them and great numbers are being exported. Requiring no more care than the varieties already mentioned, they are as hardy.

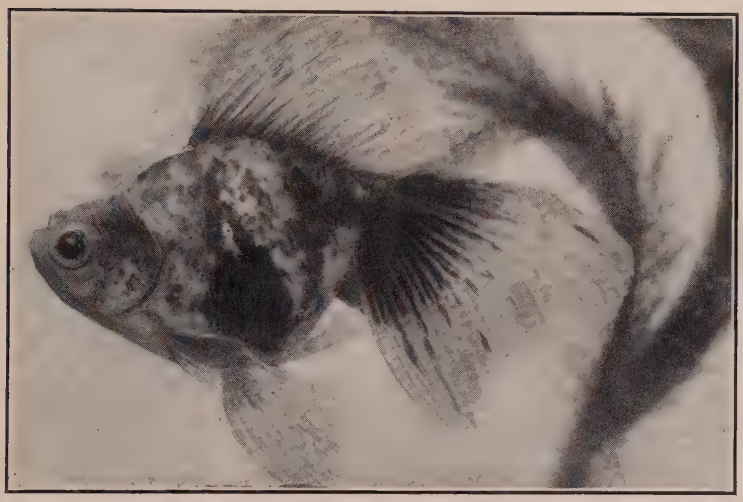
The Fantail is the first recognized step in the development of fish with two anal and two caudal fins. The Tripod and Webtails are considered sports and undesirable. The Fantail's body is nearly as long as that of the common fish and the tails, while distinctly double, are not long. Because of their agility they are good breeders and fine decorative fish for outdoor pools where snakes and rats may be encountered.

Long-tailed varieties, while graceful are such slow swimmers, they are unable to get away from these enemies.

The Nymph, a sport from the next stage of development, namely, Fringetails, while not deliberately bred, is acknowledged a permanent variety. They possess the short, rounded body of the Fringetail, a huge dorsal fin and a single tail as graceful as that of the Comet. Some have two and others only one anal fin. They are usually sold as cheap substitutes for the gorgeous Fringetails.

The Japanese Fringetail, the most pleasing of all fish to look at, has a short, chunky well-rounded body and a head shorter than that of the common fish, with a very brilliant flat eye. The length of the dorsal fin is as great as the depth of the body. All of the lower fins are paired and of great length. It exists in both scaled and scaleless varieties and is much sought after, even though it is not quite as hardy as fish of lesser development.

Nymph, a very popular fish



Chinese Telescope, a fish anyone will enjoy owning

The Barnacled Goldfish is now seldom seen and offers no attraction other than its curiosity. The scales along the sides are sharply raised and give the body the appearance of being of great size and dotted with barnacles. The first importation of these was made in 1897 from Japan, since which time none have been known to have been imported.

We now arrive at the point where the Chinese step into the raising of goldfish as a serious proposition and show us what our deep thinking, tight-mouthed Celestial friends are capable of. They are given credit for taking the Fringetail in its highest state of development and improving upon it in such a way as to set the young apart, almost entirely from their parent stock, in the form of Chinese Telescope Goldfish. These, at first sight, are a shocking curiosity, their eyes—from which they derive their name—make a lasting impression. These project at least one-quarter inch from the head and usually take on a spherical or cone shape. Eyes shaped

like tubes are rare and are sought out as prizes by fanciers. The vision afforded the fish by these telescope eyes is the same as that produced by normal eyes except in rare instances. The body is a trifle longer than that of the Fringetail, and the pectoral, anal and ventral fins are all paired, the dorsal remaining single. The caudal fins, in early types, were not very well developed, although double, their length was scarcely greater than that of the common fish. A most striking case of reversion to original type is to be seen in raising Telescopes. When newly hatched, ordinary eyes are apparent and telescope eyes seldom develop under two months. Between this and two years they may be expected any time, four months being a fair average for their development. At about a year from birth, undeveloped Chinese Telescopes are sold by some dealers for young Japanese Fringetails. For this reason it is well to select a reliable dealer when purchasing choice stock.

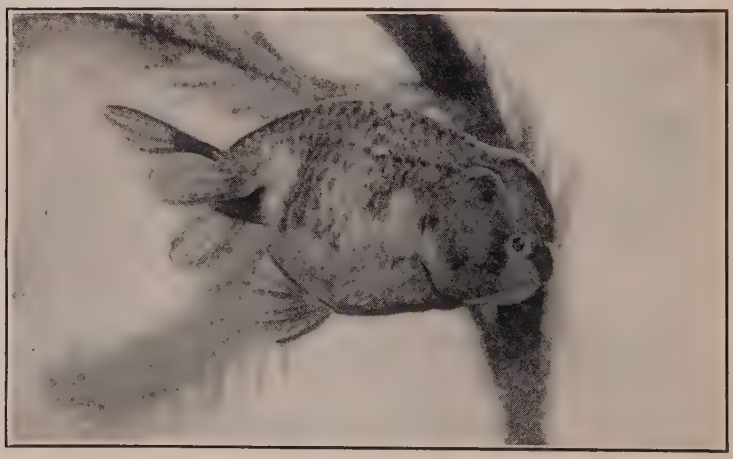
The next variety brings us to the Chinese Telescope, scaleless—a more colorful development of the last-mentioned fish. Again scaleless has been used to mean transparently scaled. These scaleless fish do not have the metallic lustre of scaled varieties, yet their appearance is more pleasing. The plain colors found in this group are red and white, or a combination of both. The calico colors, black, yellow, brown, gray, blue and lavendar, are not only the most pleasing, but eagerly sought. These colors are laid on with no regard for design, some having the appearance of being splashed with paint; in others colors appear in large patches, although no case has been known where the two adjoining colors blend themselves. Blue is the most desired color, and very few solid blues have been produced. Aside from its coloring, the scaleless Telescope—sometimes called Calico Telescopes—does not differ in bodily chacteristics from the Chinese Telescope. After color had been bred into this variety, the next step was the development of enormous fins, and by crossing the Japan-

ese Fringetail with the Chinese Telescope we have produced the scaleless Veiltail Telescope, a variety having the same number of fins as the scaleless Telescope, but a much larger dorsal fin, a trifle shorter body, and a very graceful, sweeping broad tail, called Veiltail. The credit for this step is due American breeders. While, again, Calico colors are worked for, good tail development outrates them. Should one develop a good Calico color, together with a long Veiltail, he should be much pleased. So much attention has been paid to tail development that color has been relegated to the background. Some fish retain the color of their birth, black, and show no inclination to color. This created another variety, known as the Chinese Moor Telescope. The Moor has all the earmarks of the Telescope except color. It must be a velvety black to be of value. Many fish appear black except when viewed from behind, when they are seen to be a color

The highly prized Chinese Moor Telescope

between copper and black. Fish of this color are without doubt those which have begun to color and stopped and, as a consequence, have little value, for they may color at any time. A Veiltailed Moor is a beautiful and highly prized fish. One need not fear the duplication of its color in lower grade fish.

The Chinese Celestial Telescope. The Celestial variety is one in which the coloring, finnage, etc., are the same as mentioned in the other Telescopes, except for the lack of a dorsal fin; its peculiarity being its eyes, which, instead of looking to the side or forward, have turned, and gaze heavenward, hence its name, Celestial. Many claim the Celestial eye was developed by causing the fish to be imbedded in mud with light striking it only from the top, which condition would develop this eye, from the fish looking upward to the light. This belief is erroneous. The writer recently saw Celestials bred from ordinary Calico Telescopes by an amateur. This



The grotesque Lion-head, well developed specimens of which are difficult to obtain

fish is rare, but aside from its value to the connoisseur, has little in its favor.

The Lion-headed Goldfish is another grotesque animal. While Lion-head is the name by which it is known by fanciers and dealers, the head of a well-developed specimen resembles the head of a buffalo more than its namesake. Here, again, all the fins of the Telescope are apparent except the dorsal, which is again lacking. The caudal fins being short, like the early type Telescopes, with a shorter and broader body than they, probably to take care of the increased size of head, which is covered with a heavy growth, extending past the gill plates and sometimes almost covering the eyes. Lion-heads are valuable because it usually takes four years to develop them to perfection.

The Oranda possesses all the fins of the Telescopes, a well developed pair of tails (usually veiltails), an extremely high dorsal fin, slightly longer body than the Lion-head, and a poor growth on its face and gill plates. Orondas seem to be a happy medium between Lion-heads and Telescopes, and are recognized as a variety by all associations.

Before closing this list of known fish, it might be well to mention the Chinese Lettered Goldfish. Some claims have been made for the development of fish in China in which letter characters have been bred on the bodies. No known method of breeding has duplicated the tales told by some travelers, and it is reasonable to believe the fish were either stained or branded. It may be that tales are believed in China that on American ranches, horses and cows are bred bearing the initials of their owners.

The Chinese Eggfish, is as its name implies, a fish with an egg-shaped body, transparaently scaled and white in color, lacking both dorsal and anal fins. The tails, two in number, are drooping and sharply cut, not veiltailed, and the telescope eye is but slightly developed.

Chapter III

BREEDING

THE breeding of goldfish is possible without complying with the many rules and regulations laid down by some fanciers. They may be bred in tanks or aquariums, ordinary washtubs, but undoubtedly with best results, on a small scale, in outdoor pools containing lilies. Commercial breeding is best carried on in establishments built on the south side of a hill, where ponds can be arranged to drain from one to the other, for in this way few fish will be lost through overflows, and one good source of water will suffice.

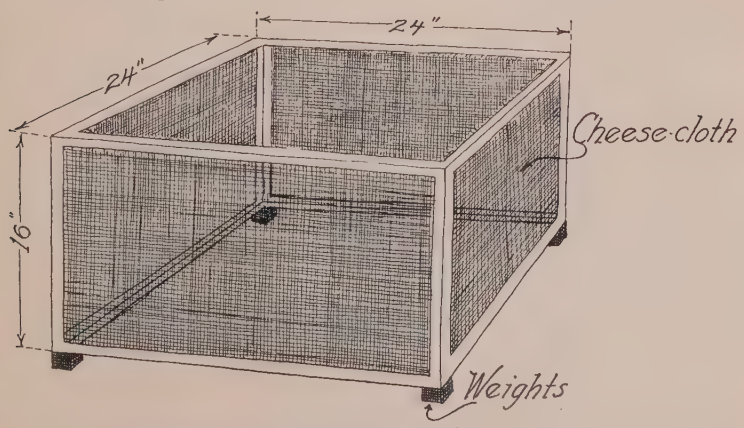
At the approach of the spawning season—that is when the temperature of the water warms to between 55 deg. and 60 deg., the sex of your fish can be easily ascertained. The male fish, or bucks, will have prominent white tubercles (white dots) about the size of the head of a pin, appearing on the gill plates, and sometimes on the forward part of the pectoral fins. The female, or roe fish, at this time is carrying spawn (eggs) and can be told by her greatly extended abdomen and lopsided appearance when viewed from above. The sexes may also be distinguished by the constant following of females by the males. The approach of spawning may be hastened not only by the raising of the temperature of the water, but also by feeding wholesome food. This is discussed in the chapter on feeding. If the breeding is to be done in an aquarium or tub, one of generous proportions should be provided. All vegetation, except that used for collecting spawn, should be removed and the fish disturbed as little as possible.

The roots of Water Hyacinths—about three plants to an aquarium—provide an admirable means of collecting spawn. If these are unobtainable, several bunches of Cabomba, Myriophyllum, or even long blades of grass firmly imbedded in a two-inch flower pot and placed on the bottom of tank or tub, will provide a good means of collecting the spawn. Not less than two males nor more than three should be placed with one female, and younger, poorer developed males are preferable to older and well developed males, because of their greater activity. Other females, not engaged in spawning should never be present as they will eat the spawn as dropped. With the tank in a good strong light, and some means provided to collect the spawn, one is ready to introduce the fish. The males should first be given the privilege of the tank and allowed its occupancy for several days in order to establish their mastery of it, after which the female should be introduced, late in the evening. If the female is ready to breed, you can learn so on the following morning by watching how carefully she is followed (called driving) by the males, who follow her every move as closely as possible. The more vigorous your males, the more capable they are of driving, and consequently the more fertile eggs you will have. If you find your fish swimming vigorously, dashing through and rubbing against your plants, you may reasonably expect spawn that day. Spawning usually begins at sunrise and continues till about noon. At about noon you must examine the plants, provided for the collection of spawn, carefully, and if conditions have been right, your reward will be a gelatinous mass of eggs clinging to the Hyacinth roots or other plants provided. These eggs were dropped by the female as she brushed against the plants, and as they fell were fertilized by the males who ejected spermatic fluid which was obsorbed by some of the spawn. The fertile eggs are almost transparent, about one-sixteenth of an inch in

diameter, and become more difficult to see as they age. Infertile eggs on their second day become white from fungus and resemble a minute ball of absorbent cotton. When sure the plants contain spawn, they should be transferred to a second container of water at the same temperature as that from which they came, to permit them to hatch; or the fish can be removed to separate tanks, permitting the spawn to remain in the original tank. At from 65 to 70 degrees the spawn should hatch in about six days, provided it has some sunlight. When the embryo bursts from the egg, it has the appearance of a thread of silk, under which is suspended at about its center a small dot. This dot is the yolk sak on which the embryo, now known as fry, feeds itself for three days. The adhesive quality of spawn, that is its ability to stick wherever deposited, seems to be retained by the fry, for they stick wherever they touch, on the sides of tanks, plants, stones, or anywhere. While swimming at first is merely a system of jerks from one place to another, they soon learn to swim easily. After three days food must be provided, and the best for this purpose is Infusoria. About one pint of water known to contain Infusoria to each 10 gallons of water being the required amount. In the absence of Infusoria, very fine rice flour can be dusted on the water, some of which will be taken by the fry; or a small quantity of oatmeal as prepared for the breakfast table and strained through muslin, can be given using only at this time the liquid part. Here, again, it is well to caution you to feed only in removable containers, as any food left in the water will sour and play havoc at this time. Feeding three or four times a day in small quantities, rather than one heavy feeding, has its advantages. After two weeks, the food can be changed to Daphnia, if available; if not, the addition of ground shrimp or ground codfish to a somewhat heavier oatmeal mixture than was at first provided for the fry will suffice. Between the ages of one and three months

the shape of the fish is molded and the lack of proper food causes a stunted growth. When it is considered that a fish at this stage consumes its own bulk of food a day, there is little likelihood of overfeeding, the chief precaution being to keep the water from souring. Some breeders, in order to enable their fish to cram as much food as possible in this period and still keep the water fresh, provide in their equipment a means of turning into the tank a drip of fresh water. An overflow pipe, well screened with several thicknesses of cheese cloth, must be provided in order to carry off the excess water and at the same time the screening will save the loss of many young fish. After three months the supply of food may be diminished, but the fish will continue to make satisfactory growth.

In pool breeding results superior to tank breeding can be accomplished with less trouble. The equipment necessary consists of a container made by covering with cheesecloth a frame built of ⅞-inch square dressed lumber about 24 inches square and 16 inches deep. The bottom should be weighted with sinkers, so as to cause at least 12 inches of its height to be submerged.



Cheesecloth covered spawning trap for use in pools

In the pool method we place the plants or means of collecting the spawn in this trap and submerge the whole to a depth of about 12 inches in a corner where it can be watched. The fish to spawn are placed in the trap and, after completion of spawning, the parent fish are again turned loose in the pool. The spawn is left in this trap to hatch and attain growth for about three weeks, when the trap can be turned on its side and the fish permitted to swin at random. When spawn is wanted from several fish at about the same time, more traps should be provided. In pools where generous plantings are provided small fish are able to take care of themselves, requiring only suitable food. A great quantity of natural food is found in all pools. Strict attention to the removal of unconsumed artificial food must of course be observed. The amateur, breeding fish for the first time, will obtain better results from the use of the more hardy varieties, such as the common fish or the Comet, for his early experiments, later progressing to the Telescope class. After a thorough knowledge has been obtained in handling fish in either of these two manners, breeding on a wholesale scale may be accomplished with ease, no expensive equipment being required.

Chapter IV

FISH FOODS

UNLIKE the lady who believed the goldfish she had kept for several years required no food, we know by this time that fish do need food, and the better the fish the more exacting its food requirements. Even as vegetable life is necessary in the water with fish, so is a balance of several food factors necessary. A well-balanced artificial food should consist of both animal and mineral matters with a cereal added for its vegetable content as well as bulk. The keeper of few fish will find it more profitable to purchase his fish food rather than to attempt its manufacture. When making your purchase, open the box and assure yourself of its animal matter content by a distinct animal smell. Any reputable dealer can suggest one for your purpose from his stock. Beware, however, of the wafer food sold under many Japanese and American names. As fish food it has no value whatever for growing fish, and due to the careless use of it by the inexperienced, many thousands of fish are killed yearly.

Oatmeal. Either the dried rolled oats or prepared by cooking as served at your table forms a splendid article of food for the common and highly developed varieties. Be moderate in the quantity you feed and see that none is permitted to remain after feeding to sour the water, and little more could be wanted.

Boiled vegetables—especially carrots—spinach, or any greens, form a most delightful change for your pets, and the use of them causes a laxative effect on the fish, which is much desired because of the lack of exercise while in confinement.

Wholesale breeders of common fish are required to breed such numbers in order to make the venture a profitable one, that live food or expensive artificial foods are beyond their means. Almost all of them use low grade cereals, such as corn and wheat middlings, beanmeal, etc., in both dried and cooked forms.

Hard-boiled eggs, when run through a ricer or food chopper, provide a very fine conditioning as well as sustaining food. The eggs must be boiled at least thirty minutes to insure their digestibility. A breeder of the writer's acquaintance is able to bring his roe fish (in a greenhouse) into breeding condition at any time by about two weeks daily usage of hard-boiled eggs. Much has been said and written concerning the value of scrambled eggs as a fish food. Tests have been made with various articles of food as prepared for human consumption and all have been eagerly devoured by hungry fish, but no great inroads have been made on the established articles of fish food either by these or scrambled eggs. Both remain an open question to the writer.

Powdered shrimp and powdered codfish are both excellent articles of food, but moderation in their use is advisable. Powdered codfish is made by drying in a slow oven a package of shredded codfish, as carried in stock by all grocers. After all the moisture is dried out it is run through a mincer or food chopper or any other method at hand to reduce the food to a fine consistency. For small quantities the use of a mortar and pestle is advised. Powdered shrimp is obtainable from nearly all pet dealers.

For the fancier who takes pleasure in the manufacture, so far as possible of his own necessities, I give the following recipe for a general fish food:

To one pound of whole wheat flour, add one-half ounce of baking powder, one-quarter ounce of Epsom salt, and one-half ounce of powdered cuttlefish bone. Thoroughly mix

these ingredients and then add two ounces of powdered codfish and four ounces of powdered shrimp. Stir the whole mixture well until the shrimp and codfish are well distributed; then add two raw eggs which have been whipped until light and enough water to make a stiff dough. Without unnecessary delay, place in a baking dish and bake in a slow oven, as you would bread. When done remove from the oven and permit to cool and stand for a day or two to partially dry out. Then cut into thin slices and again place in a very slow oven until all moisture has been removed, after which it can be ground to size as required and placed in tightly sealed tins or jars and placed in a cool cellar until needed.

Dried fish roe and dried daphnia are often mentioned but little used, for the reason that their real food value is lost at the death of their life germ.

Bloodmeal was at one time a highly favored food, but has lost its favor by its habit of causing fungus when fed without extreme care.

While any of the artificial foods mentioned give good results, fish do better on live matter, as that is their natural food.

Earthworms of the garden variety are a most valuable form of food to highly developed goldfish, the smaller ones (about two inches long) are ideal. The worms should be prepared by cutting into lengths of about one-quarter inch, and only such quantities given as will be consumed in about twenty minutes. Earthworms can be collected in the early Fall and stored in a cool, damp spot in the cellar in rich dirt. They require little food and about one teaspoonful of mashed potatoes weekly will carry a goodly number over Winter. The dungworm, easily found in manure pits, is not as suitable as the garden variety.

Mosquito larvæ—easily obtained from any pool of stagnant water—is an excellent article of food for goldfish.

Infusoria, the first natural food for very small fish, consists of many kinds of microscopic animalculæ found in still water and is indispensable for small fish. In natural ponds this is also found by the fish and under artificial conditions we are bound to supply it for our small and growing stock. If one examines exposed water which has stood a few days, these minute creatures can be seen. Their creation will be taken up with the creation of daphnia, a fresh water crustacean, the supreme food for highly developed goldfish. Daphnia, also known as ditch fleas, is a creature found in fresh water ponds in all parts of the world, and quantities of them can be obtained from still ponds not provided with fish. Daphnia approximate the size and shape of a flea, except for the swimming arms, which propel the animals in a jerky motion through water. When disturbed, they dive to the bottom and bury themselves in the soft mud or decaying leaves usually found there. When all is quiet they again rise to the surface and color the top of the water with their rusty appearance. The brighter colored daphnia are more eagerly sought by the fish. A walk through the woods to a quiet pool will afford an opportunity to see them. Enough of the daphnia

An ideal commercial fish farm, located in the Blue Ridge Mountain district. The owner, Mr. E. R. Powell, has here made good use of the natural resources of his section, his ponds having been built on the side of a mountain, which

can be propagated at home to feed a small quantity of fish by the following method:

First, obtain a good size barrel or hogshead and saw it in two through the center, giving two half-barrel containers. In the first, spoken of as No. 1, we place about two inches of good, rich garden dirt and on top of this about one inch of dried leaves. It is then filled with water to within a few inches of the brim and placed where it will be shaded at least one half of each day. The other half, for convenience called No. 2, is filled to nearly its brim with water and permitted to stand where it will have about the same light conditions as No. 1. A discarded water bucket is the only other vessel required and in it is placed several inches of fresh cow manure and it is then filled with water. In tub No. 2, we suspend, in a flower sieve or any other like container, all the old and decaying lettuce leaves to be found. In the absence of lettuce leaves, marsh grass, such as is found around the banks of stagnant marshes, will answer; or if neither of these is obtainable, a small bag of rice flour may be suspended in the water. If we examine this water with a low-powered microscope, in about four or five days we find it fairly alive with

made excavation unnecessary. Only one spring serves all these ponds with water as they are arranged to overflow into each other. (Note mountains in the background)

minute organisms. These are infusoria, food for our very young fish as well as our daphnia. In container No. 1 we place about one-half pint of daphnia. If you have been unsuccessful in your hunt for daphnia, the members of your local aquatic association will tell you where they can be obtained, or some fancier friend will give you enough from his stock to start a culture of your own. In the handling of daphnia care must be exercised not to mash or squeeze them, as their shells are delicate and stand very little pressure. The few daphnia in this container will settle down to work in a few days and reproduce themselves in enormous quantities. Your only other duty will be to feed about one pint of infusoria water to them each day, and about one-half pint of the cow manure water (strained) from the bucket twice each week, with the occasional addition of about one teaspoonful of powdered chalk or cuttlefish bone to provide material for making their shell. Daphnia can be dipped from tub No. 1 each day in quantities sufficient to take care of your feeding needs. A little care must be used in maintaining enough water for the number of daphnia you have in your tub. If you find a number of them dead, it is safe to assume they have depleted the water of oxygen and fresh water must be added or, better still, a small drip of water can be turned in, provided a well-screened drain is built to keep them from washing away. For breeding large numbers of daphnia, a large pool would be required, and the same methods as mentioned applied on a larger scale. In Winter the daphnia will bury themselves in the mud at the bottom of the barrel and emerge safe and sound with renewed energy in the Spring.

Numerous live foods have been used from time to time, but their regular use is not recommended.

Chapter V

FISH DISEASES AND REMEDIES

ALMOST all diseases of fish can be traced to some direct cause and without exception are caused by careless methods of keeping or handling fish. It is better to prevent disease rather than cure it. In some few cases, such as digging in banks for worms, the fish bring disease on themselves, and even in a wild state some disease is found. If we thoroughly quarantine each of our new prizes in a weak solution of Potassium Permangate for a few days before placing with our other fish, much disease will be prevented. A drooping dorsal fin, white scum on the body, or bubbles in the excrement are signs of failing health.

All animals, in their wild state, seek out salt beds or streams of brackish water, because they are instincted to know that bacteria of sufficient strength to cause disease are too weak to live in even a mild salt solution. Fish known to be off color, when placed in a mild salt solution—so mild that the salt is just discernible to human taste—and kept at a temperature of 68 degrees, invariably brighten up in a day or two, when they may be transferred back to their permanent quarters It is better to make a fresh salt solution each day rather than use a stale one.

Occasionally a fish will brush against a stiff plant or the side of a pool and cause a bare spot to appear on its body. It then develops the common fish disease known as white fungus. White scum forms on the affected part and grows all over the fish, destroying fins and fraying tails, also pre-

venting natural functions of the skin. When permitted to continue, the fungus parasite gets into the gills of fish and causes suffocation by sealing the tiny pores. This disease also increases through the use of improper food. The number of fungi present in all water can increase to a point where they weaken a fish and finally attack it. Sudden changes of temperature also weaken fish and increase their susceptibility to this disease. Because the disease is contagious, the affected fish should be transferred to a clean receptacle, and if fins are badly frayed, they may be trimmed by laying the patient on a board and by the skillful application of a safety razor blade remove all frayed parts. Swab the affected parts with a solution of potassium permanganate, about five drops of a saturated solution of same to about one ounce of water, and then place in a mild salt solution for several days. This treatment can be repeated without causing any damage. Another remedy—in all probability the best—is to remove as much of the fungus as possible by gently stroking the patient with a wad of absorbent cotton moistened with a strong permanganate solution and then covering the parts affected with a light coat of petroleum jelly. Then place the patient in mild salt water for several days.

Fin congestion—another common disease—is known principally in highly developed fish; their long fins become streaked with bloody veins and split and fray, most noticeable on the caudal fins. Low or sudden changes of temperature are its principal causes. Petroleum jelly, as used for fungus, is a good remedy for fin congestion. Another very successful one is to place the affected fish in a glass receptacle containing a weak solution of potassium permanganate for about three hours every other day. On alternate days a weak salt solution should be used.

Constipation is usually caused by rich food and lack of exercise, especially among the highly bred, short-bellied fish.

This disease seldom appears when Epsom salt is added to the water, as mentioned in the chapter on management. However, should the excrement from your fish contain bubbles or appear slimy, you can safely treat them for constipation. No treatment is better than a mixture of sea and Epsom salt made in a strength of about one tablespoonful of each to a gallon of water. The fish is permitted to remain in this solution for about twenty-four hours without food, when the distress will be removed.

Tailrot affects the ends of tails and other fins and looks like an extreme case of fin congestion. It does not yield readily to any of the foregoing treatments, but is effectively handled by placing the tails or fins affected in a 50 per cent solution of peroxide of hydrogen and then returning to the water. In a few days the parts affected will drop off from the body and cause no further trouble.

Swimming Bladder Disease, found principally in Telescopes, causes a loss of equlibrium, the fish being unable to rise from the bottom to the surface of the water, or *vice versa*. No real cure for this disease is known, and if the specimen is not a valuable one it may just as well be destroyed.

Indigestion symptoms are almost like those of Swimming Bladder Disease but will yield readily to the treatment for constipation.

While little is known of Gill Fever, which attacks young fish and causes wholesale deaths, a weak solution of potassium permanganate has been used with some success.

Dropsy, another unusual disease attacking fancy fish, is relieved by tapping the fish with a sterilized needle and permitting some of the fluid near the surface to escape, which will relieve the patient temporarily. To my knowledge no real cure is known.

Consumption is invariably caused by malnutrition, and a change to a more wholesome diet effects many cures.

Fish lice, while not a disease, are very annoying. They are rather flat, about three-sixteenths of an inch in diameter, and have an uncanny way of sticking to fish. They cause most damage when they enter the gills, from which they are hard to extract, except by picking them out with a fine pair of tweezers. While they can be picked off, they will leave of their own accord if touched with kerosene.

Itch, a very common disease, causes the fish to rub plants or other objects in order to relieve themselves. A day in a mild salt solution will remove the cause.

Black fungus, similar to white fungus, except for the color, is so rare as to cause no trouble.

While other diseases may be mentioned, they are rare and need not take up the time of the amateur, for whom this work has been compiled. It is hoped the aquarist will use every preventive measure at his command to combat disease.

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